



**Injury Prevention Report No. S.0000614-10, 10 December 2012**  
**Epidemiology and Disease Surveillance Portfolio**

**Deployment Surveillance Summary, U.S. Army Operation Iraqi Freedom/  
Operation New Dawn/Operation Enduring Freedom, 2010**

**Prepared by: Bonnie Taylor, Avni Patel, Keith Hauret, Bruce Jones, and the  
Injury Prevention Program**

**Approved for public release; distribution unlimited.**

**General Medicine: 500A**

Report Documentation Page			Form Approved OMB No. 0704-0188		
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE <b>10 DEC 2012</b>		2. REPORT TYPE <b>Technical Report</b>		3. DATES COVERED <b>01-01-2010 to 31-12-2010</b>	
4. TITLE AND SUBTITLE <b>Deployment Surveillance Summary, U.S. Army Operation Iraqi Freedom/Operation New Dawn/Operation Enduring Freedom, 2010</b>			5a. CONTRACT NUMBER		
			5b. GRANT NUMBER		
			5c. PROGRAM ELEMENT NUMBER		
6. AUTHOR(S) <b>Bonnie Taylor; Avni Patel; Keith Hauret; Bruce Jones</b>			5d. PROJECT NUMBER		
			5e. TASK NUMBER		
			5f. WORK UNIT NUMBER		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>U.S. Army Public Health Command, Army Institute of Public Health, Aberdeen Proving Ground, MD, 21010</b>			8. PERFORMING ORGANIZATION REPORT NUMBER <b>Report No. S.0000614-10</b>		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)			10. SPONSOR/MONITOR'S ACRONYM(S)		
			11. SPONSOR/MONITOR'S REPORT NUMBER(S)		
12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release; distribution unlimited</b>					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT <b>The aims of this report on injuries to Soldiers engaged in Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF)/Operation New Dawn (OND) are to: a. Describe the relative impact of injury compared to that of disease for calendar year (CY) 2010. b. Document non-battle injury (NBI) rates and trends from 2003 to 2010. c. Identify leading causes and diagnoses of non-battle injury for CY 2010. d. Summarize key U.S. Army Public Health Command (USAPHC) CY 2010 analytic deployment surveillance projects on injuries among deployed Soldiers. e. Make recommendations for the improvement of Army injury prevention based on data analyzed. Routinely collected air evacuation, inpatient hospitalization, and casualty data provide the basis for deployment injury surveillance during current Army deployments in support of OIF/OND and OEF. Non-battle injury was notably the most significant cause of medical evacuations. As in previous years, the proportion of air-evacuated NBIs is larger than that of BIs and any other single category of disease, and it greatly impacts readiness. As in CY 2009, NBI was second to digestive diseases for OIF/OND hospitalizations and second to battle injuries for OEF hospitalizations. Similar to previous reports, the leading causes of these NBIs indicate that many are likely preventable. Timely reporting of injury rates, types, and causes should allow commanders and Army leaders to focus their attention on prevention strategies and policies during ongoing operations.</b>					
15. SUBJECT TERMS <b>military, Army, injuries, NBIs, surveillance, OIF, OEF, OND</b>					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT <b>Same as Report (SAR)</b>	18. NUMBER OF PAGES <b>54</b>	19a. NAME OF RESPONSIBLE PERSON
a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>			





DEPARTMENT OF THE ARMY  
US ARMY INSTITUTE OF PUBLIC HEALTH  
5158 BLACKHAWK ROAD  
ABERDEEN PROVING GROUND MD 21010-5403

MCHB-IP-DI

EXECUTIVE SUMMARY  
INJURY PREVENTION REPORT NO. S.0000614-10  
U.S. ARMY OPERATION IRAQI FREEDOM/OPERATION NEW DAWN/OPERATION  
ENDURING FREEDOM DEPLOYMENT INJURY SURVEILLANCE SUMMARY  
1 JANUARY 2010–31 DECEMBER 2010

1. PURPOSE. The aims of this report on injuries to Soldiers engaged in Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF)/Operation New Dawn (OND) are to:

- a. Describe the relative impact of injury compared to that of disease for calendar year (CY) 2010.
- b. Document non-battle injury (NBI) rates and trends from 2003 to 2010.
- c. Identify leading causes and diagnoses of non-battle injury for CY 2010.
- d. Summarize key U.S. Army Public Health Command (USAPHC) CY 2010 analytic deployment surveillance projects on injuries among deployed Soldiers.
- e. Make recommendations for the improvement of Army injury prevention based on data analyzed.

2. CONCLUSIONS.

a. Routine Deployment Injury Surveillance Summary 2010, Army OIF/OND and OEF. Routinely collected air evacuation, inpatient hospitalization, and casualty data provide the basis for deployment injury surveillance during current Army deployments in support of OIF/OND and OEF. Non-battle injury was notably the most significant cause of medical evacuations. As in previous years, the proportion of air-evacuated NBIs is larger than that of BIs and any other single category of disease, and it greatly impacts readiness. As in CY 2009, NBI was second to digestive diseases for OIF/OND hospitalizations and second to battle injuries for OEF hospitalizations. Similar to previous reports, the leading causes of these NBIs indicate that many are likely preventable. Timely reporting of injury rates, types, and causes should allow commanders and Army leaders to focus their attention on prevention strategies and policies during ongoing operations.

b. Special Analytic Deployment Injury Surveillance Project Summaries, 2010.

(1) The annual NBI fatality rate for OEF was almost two times higher than that for OIF (OEF: 130/100,000 soldier-years; OIF: 71/100,000). The leading cause of NBI fatalities for OIF and OEF combined were land transport accidents, intentionally self-inflicted injuries, and air transport accidents.

(2) Falls were the leading cause (25 percent) of serious NBIs air evacuated from Iraq and Afghanistan. These injuries, many of which are preventable, negatively impact soldier work performance and unit readiness during deployments.

(3) Sports and exercise-related injuries comprised 21 percent of NBIs air evacuated from Iraq and Afghanistan. Due to the impact of these injuries on lost duty time and military readiness, identifying, evaluating and implementing strategies to prevent these injuries is a high priority for military leaders.

3. RECOMMENDATIONS.

a. Continue routine surveillance of deployment injuries and annual updates of this deployment injury surveillance report.

b. Link additional data sources, such as levels IV and V hospitalizations and disability records, to provide an enhanced description of deployment injuries and their outcomes.

c. Continue investigation to identify modifiable risk factors that contribute to the leading causes of injury.

d. Focus attention on strategies to prevent injuries from sports/physical training, falls/jumps, and land transport mishaps.

## TABLE OF CONTENTS

Paragraph	Page
1. REFERENCES.....	1
2. PURPOSE.....	1
3. AUTHORITY .....	1
4. ROUTINE DEPLOYMENT INJURY SURVEILLANCE SUMMARY, ARMY OPERATION IRAQI FREEDOM (OIF)/OPERATION NEW DAWN (OND) and OPERATION ENDURING FREEDOM (OEF), 2010	
a. Background.....	1
b. Methods .....	2
c. Results .....	4
d. Discussion .....	29
e. Recommendations .....	32
5. SPECIAL ANALYTIC DEPLOYMENT INJURY SURVEILLANCE PROJECT SUMMARIES, 2010	
a. Distribution and Causes of Fatal Non-battle Injuries during OEF and OIF, 2001-2009 .....	33
b. Fall-related Injuries as a Leading Cause of Injury among Deployed Army Soldiers .....	35
c. Sports Injuries among Active Service Members Deployed for OIF and OEF, 2001-2008 .....	37
d. Conclusions .....	39
e. Recommendations .....	40
6. POINT OF CONTACT .....	41
Appendices	Page
A. REFERENCES .....	A-1
B. BARELL INJURY DIAGNOSIS MATRIX AND ASSOCIATED ICD-9-CM 800-995 CODES .....	B-1
C. INJURY-RELATED MUSCULOSKELETAL CONDITION MATRIX AND ASSOCIATED ICD-9-CM 710-739 CODES .....	C-1

List of Figures	Page
1. Distribution Percentage (%) of Injury and Disease by Diagnosis Category among Air-evacuated U.S. Army Soldiers, OIF/OND, CY 2010 .....	5
2. Distribution Percentage (%) of Injury and Disease by Diagnosis Category among Air-evacuated U.S. Army Soldiers, OEF, CY 2010.....	6
3. Distribution Percentage (%) of Injury and Disease by Diagnosis Category among Hospitalized U.S. Army Soldiers, OIF/OND, CY 2010.....	7
4. Distribution Percentage (%) of Injury and Disease by Diagnosis Category among Hospitalized U.S. Army Soldiers, OEF, CY 2010 .....	8
5. Non-battle Injury Rates among U.S. Army Soldiers Deployed for OIF/OND, CY 2003–2010 .....	11
6. Non-battle Injury Rates among U.S. Army Soldiers Deployed for OEF, CY 2003–2010 .....	12
7. Battle Injury Rates (Air Evacuations, Hospitalizations, and Deaths) among U.S. Army Soldiers Deployed for OIF/OND, CY 2003–2010 .....	13
8. Battle Injury Rates (Air Evacuations, Hospitalizations, and Deaths) among U.S. Army Soldiers Deployed for OEF, CY 2003–2010.....	14
9. Distribution of Causes of Battle Injury Deaths among U.S. Army Soldiers Deployed for OIF/OND, CY 2010 .....	15
10. Distribution of Causes of Battle Injury Deaths among U.S. Army Soldiers Deployed for OEF, CY 2010.....	16
11. Distribution of Leading Causes of Non-battle Injury Air Evacuations among U.S. Army Soldiers Deployed for OIF/OND and OEF, CY 2010.....	18
12. Distribution of Leading Causes of Non-battle Injury Hospitalizations among U.S. Army Soldiers Deployed for OIF/OND and OEF, CY 2010.....	19
13. Distribution of Leading Causes of Non-battle Injury Deaths among U.S. Army Soldiers Deployed for OIF/OND and OEF, CY 2010.....	20

14. Annual Rate of Fatal Non-battle Injuries, CY 2001–2009.....	34
15. Causes of Fatal Non-battle Injuries, OIF/OEF, CY 2001–2009 .....	35
16. Primary Causes of Air-evacuated Non-battle Injuries, Iraq and Afghanistan, CY 2001–2009 .....	36
17. Annual Rate of Non-battle and Fall-related Injuries, Iraq and Afghanistan, CY 2001–2009 .....	37
18. Distribution of Anatomical Location for Sports and Exercise-related Injuries Air-evacuated from Iraq and Afghanistan, CY 2001–2008.....	39

List of Tables	Page
1. Battle Injury, Non-battle Injury, and Disease among U.S. Army Soldiers Deployed for OIF/OND, CY 2010 .....	9
2. Battle Injury, Non-battle Injury and Disease among U.S. Army Soldiers Deployed for OEF, CY 2010.....	10
3. Injury Intention for Non-battle Injuries, OIF/OND and OEF, CY 2010.....	17
4. Frequency of Air-evacuated Traumatic Non-battle Injuries by Type and Location of Injury, U.S. Army, OIF/OND and OEF, CY 2010 .....	22
5. Frequency of Air-evacuated Non-battle Injury-related Musculoskeletal Conditions by Type and Location of Injury, U.S. Army, OIF/OND and OEF, CY 2010.....	24
6. Frequency of Traumatic Hospitalized Non-battle Injuries by Type and Location of Injury, U.S. Army, OIF/OND and OEF, CY 2010 .....	26
7. Frequency of Hospitalized Non-battle Injury-related Musculoskeletal Conditions by Type and Location of Injury, U.S. Army, OIF/OND and OEF, CY 2010.....	28
8. Distribution of the Five Most Common Injuries for Basketball, Football, Physical Training, and Weightlifting, CY 2001–2008.....	38



INJURY PREVENTION REPORT NO. S.0000614-10  
U.S. ARMY OPERATION IRAQI FREEDOM/OPERATION NEW DAWN /OPERATION  
ENDURING FREEDOM DEPLOYMENT INJURY SURVEILLANCE SUMMARY  
1 JANUARY–31 DECEMBER 2010

1. REFERENCES. References are listed in Appendix A.
2. PURPOSE. The aims of this report on injuries to Soldiers engaged in Operation Iraqi Freedom (OIF)/Operation New Dawn (OND) and Operation Enduring Freedom (OEF) are to—
  - a. Describe the relative impact of injury compared to disease for calendar year (CY) 2010.
  - b. Document non-battle injury (NBI) rates and trends from 2003 to 2010.
  - c. Identify leading diagnoses and causes of NBI for CY 2010.
  - d. Summarize key U.S. Army Public Health Command (USAPHC) CY 2010 analytic deployment surveillance projects on injuries among deployed Soldiers.
  - e. Make recommendations for the improvement of Army injury prevention based on data analyzed.
3. AUTHORITY. Army Regulation (AR) 40-5, *Preventive Medicine*, 25 May 2007; Section 2-19.
4. ROUTINE DEPLOYMENT INJURY SURVEILLANCE SUMMARY, ARMY OIF/OND and OEF, 2010.
  - a. Background. Injuries are a major health problem confronting U.S. military forces in garrison and combat operations.<sup>(1,2)</sup> For past conflicts, data on injuries were available only after the conflict. In current conflicts, there is timelier reporting of both battle injuries (BIs) and non-battle injuries (NBIs). For the present operations in Iraq and Afghanistan, NBIs have accounted for a larger proportion of medical air evacuations than BIs or any other individual disease diagnosis group.<sup>(3-9)</sup> Previous deployment injury surveillance reports have provided injury rates and trends which were used to develop targeted prevention efforts on those injuries with the highest or increasing rates.<sup>(8-11)</sup> To prevent injuries, knowledge of the causes of injuries is also needed. The data in this report are unique in that they identify the causes of NBI in

addition to BI. This report provides a foundation for setting deployment injury prevention priorities based on the magnitude, severity, and causes of injuries.

b. Methods.

(1) Population.

(a) This report describes BIs and NBIs among all deployed Army Soldiers (active duty, Reserve, and National Guard) in support of OIF/OND and OEF between 1 January 2010 and 31 December 2010 that resulted in:

- i. Air evacuation from the Central Command (CENTCOM) area of responsibility (AOR),
- ii. Hospitalization in the CENTCOM AOR, and/or
- iii. Death.

(2) Data Sources.

(a) Air-evacuated Injuries. Injury data for Soldiers air evacuated from CENTCOM were obtained from the U.S. Transportation Command's Regulating and Command and Control Evacuation System (TRAC<sup>2</sup>ES). These data are routinely collected and used to request and coordinate medical air evacuation of Service members with serious injuries and diseases.

(b) Hospitalized Injuries. Standard Inpatient Data Records (SIDR) for hospitalizations in the CENTCOM AOR were obtained from the Patient Administration Systems and Biostatistics Activity (PASBA), a component of the Decision Support Center, Office of the Surgeon General. These electronic records were created from medical records that were forwarded to PASBA after Soldiers were hospitalized during deployments. These SIDR records are the official electronic record of a hospitalization in a Department of Defense (DOD) medical facility.

(c) Fatal Injuries.

i. Fatal Non-battle Injuries. Fatality data for the number and causes of NBI deaths and for the number of deaths from disease were obtained from the Defense Casualty Information Processing System (DCIPS). These data are routinely collected and used for casualty tracking and mortuary affairs.

ii. Fatal Battle Injuries. Fatality data for the number and causes of BI deaths were obtained from the Defense Manpower Data Center (DMDC).

(3) Identification and Description of Injury Cases.

(a) Relative Importance of Injury and Disease. Primary Diagnosis Groups from the International Classification of Diseases, 9<sup>th</sup> Revision, Clinical Module (ICD-9-CM) and BI/NBI/Disease indicators in the air evacuation records (TRAC<sup>2</sup>ES) and hospitalization records (SIDR) were used to determine the relative importance of injuries (NBI and BI) and diseases among all medical air evacuations from CENTCOM and hospitalizations within CENTCOM.

(b) Exclusion Criteria.

i. To prevent double counting, a 60-day air evacuation exclusion was used to prevent the double counting of Soldiers who were air evacuated from CENTCOM for the same diagnosis within a 60-day timeframe of the initial event. All out-of-CENTCOM air evacuation patient movements are included.

ii. Similarly, a 30-day hospitalization exclusion was used so that injury hospitalizations for the same diagnosis (3-digit ICD-9-CM code) in the same individual within a 30-day timeframe of the initial event were not included in the analysis. This 30-day timeframe accounts for distinct injuries, considering that some injuries required multiple hospitalizations.

iii. Injuries that required air evacuation within CENTCOM only (that is, further evacuation from CENTCOM was not required) were excluded from the air evacuation analyses.

(c) Injury Rate Calculations. Injury rates for NBIs and BIs have been calculated in this report. An annual injury rate was determined by dividing the number of injured Soldiers for the year by the total number of deployed person-years for that year. Information for number of deployed persons per year was obtained from the Joint Chiefs of Staff, Manpower and Personnel Directorate.<sup>(12)</sup>

(d) Causes of Injury (NBIs and BIs).

i. Air-evacuated Injuries. The type of intent (intentional and unintentional) and the causes of injury were identified from narrative patient histories in the air evacuation records. Trained coders used the North Atlantic Treaty Organization (NATO)

Standardization Agreement (STANAG) No. 2050, 5<sup>th</sup> Edition (Military Agency for Standardization, 1989) coding scheme to categorize the causes of injury.<sup>(13)</sup>

ii. Hospitalized Injuries. The STANAG-coded causes of injury were already present in the in-CENTCOM hospitalization records (SIDR) from PASBA and were used to determine the intent and cause of injury.

iii. Fatal Non-battle Injuries. Causes of fatal NBIs were identified from casualty reports in DCIPS records. As with the air evacuation records, trained coders used the STANAG coding scheme to categorize the cause of injury.

iv. Fatal Battle Injuries. Causes of fatal BIs were included in the fatality data from DMDC and were used to determine the intent and cause of injury.

(e) Type of Injury by Body Region Matrices for NBIs.

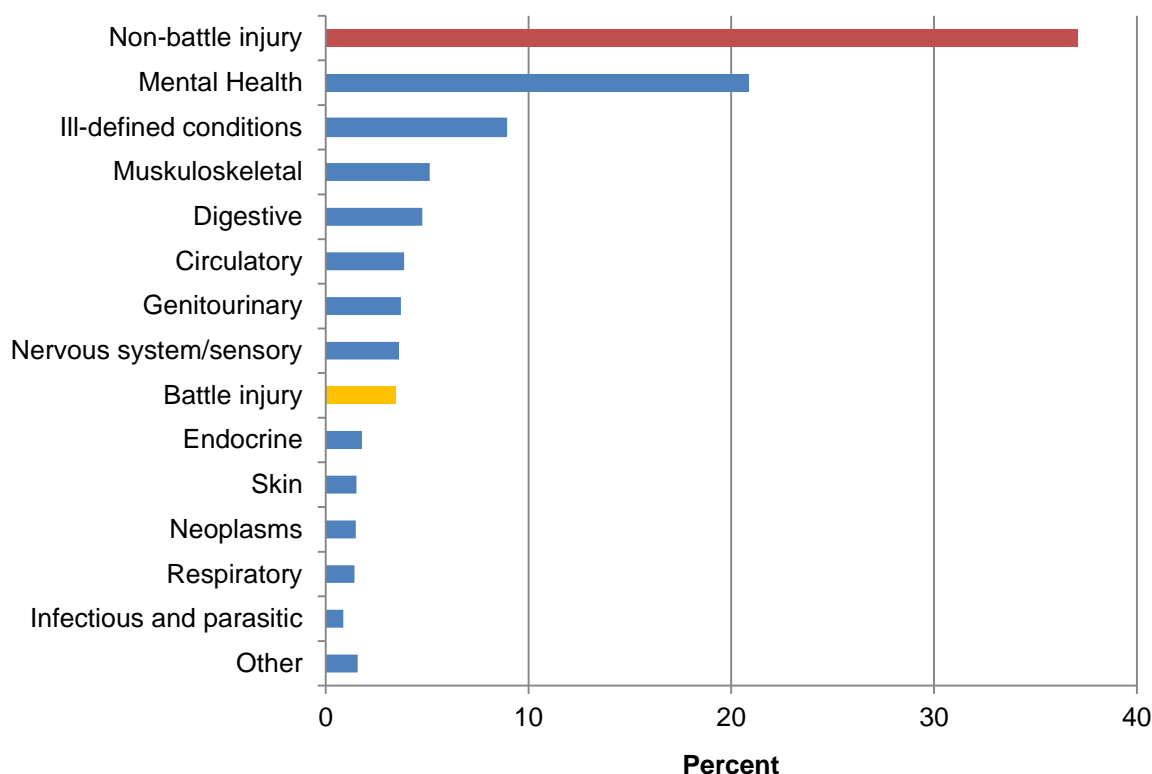
i. The NBIs were categorized into two subgroups: 1) acute traumatic injuries and 2) injury-related musculoskeletal conditions. A matrix was used to categorize the injuries in each of the NBI subgroups by injury type (such as fracture, dislocation, sprain/strain, etc.) and body region.

ii. The Barell injury matrix<sup>(14)</sup> was used to display injury frequencies for acute traumatic NBIs (ICD-9-CM codes 800-995; see Appendix B) in a standardized format in which the type of injury is listed horizontally, across the top of the table, and the body region is listed vertically, along the left side of the table. Two Barell matrices are shown; one includes only those NBIs that required out-of-CENTCOM air evacuation, and the other includes only those NBIs that required in-theater hospitalization.

iii. A similar matrix format was used to display the frequencies of injury-related musculoskeletal conditions (subset of ICD-9-CM codes 719-739; see Appendix C). Two musculoskeletal matrices are shown; one includes only those NBIs that required out-of-CENTCOM air evacuation, and the other includes only those NBIs that required in-theater hospitalization.

c. Results.

(1) Medical air evacuation distribution, OIF/OND. Figure 1 shows the percentage of injuries and disease by primary diagnosis groups (ICD-9-CM code) for the OIF/OND out-of-CENTCOM medical air evacuations in CY 2010.



Note: Includes injury and disease resulting in out-of-CENTCOM air evacuation for 3,103 Soldiers.

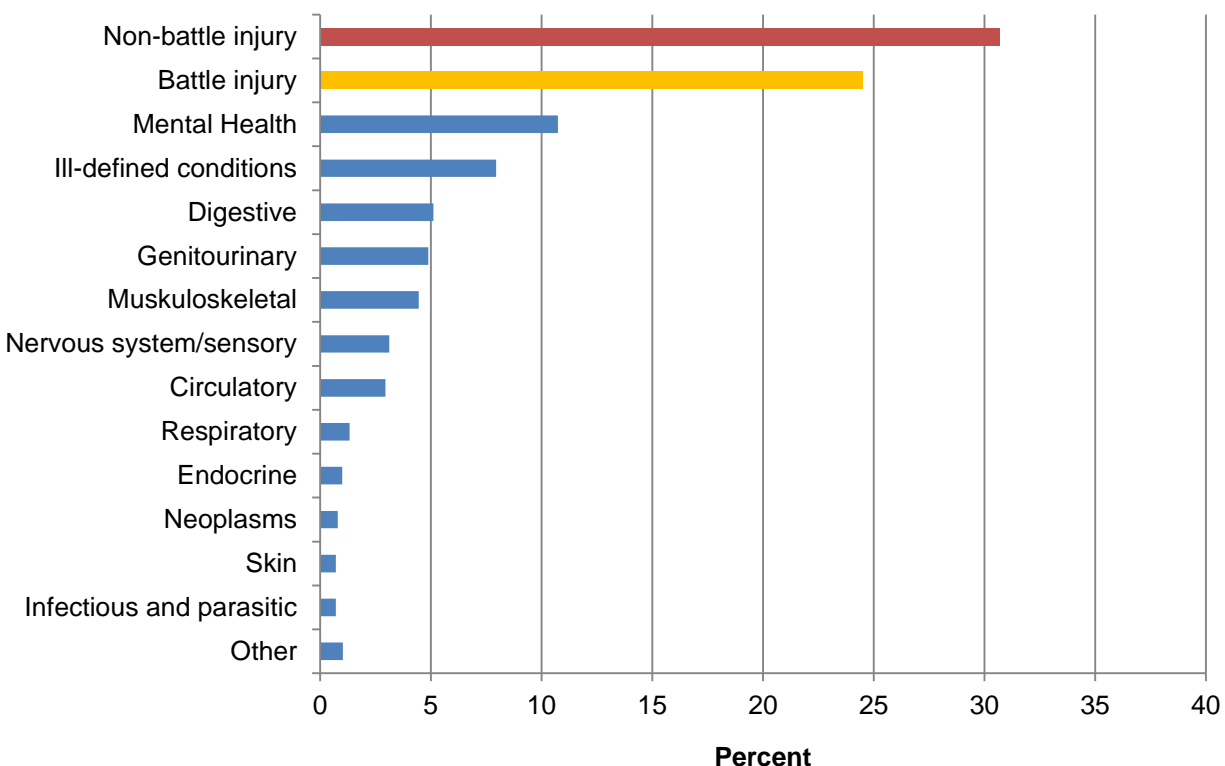
Figure 1. Distribution Percentage (%) of Injury and Disease by Diagnosis Category among Air-evacuated U.S. Army Soldiers, OIF/OND, CY 2010

(a) In 2010, 3,103 Soldiers in OIF were medically air-evacuated to out-of-CENTCOM medical facilities.

(b) Non-battle injuries accounted for 37.1 percent (n=1,078) of these air evacuations, while the leading disease diagnosis group, “mental health,” accounted for 20.9 percent (n=647).

(c) Battle injuries accounted for 3.4 percent (n=107) of the air evacuations from OIF/OND.

(2) Medical air evacuation distribution, OEF. Figure 2 shows the percentage of injuries and disease by primary diagnosis groups (ICD-9-CM code) for OEF out-of-CENTCOM medical air evacuations in CY 2010.



Note: Includes injury and disease resulting in out-of-CENTCOM air evacuation for 3,397 Soldiers.

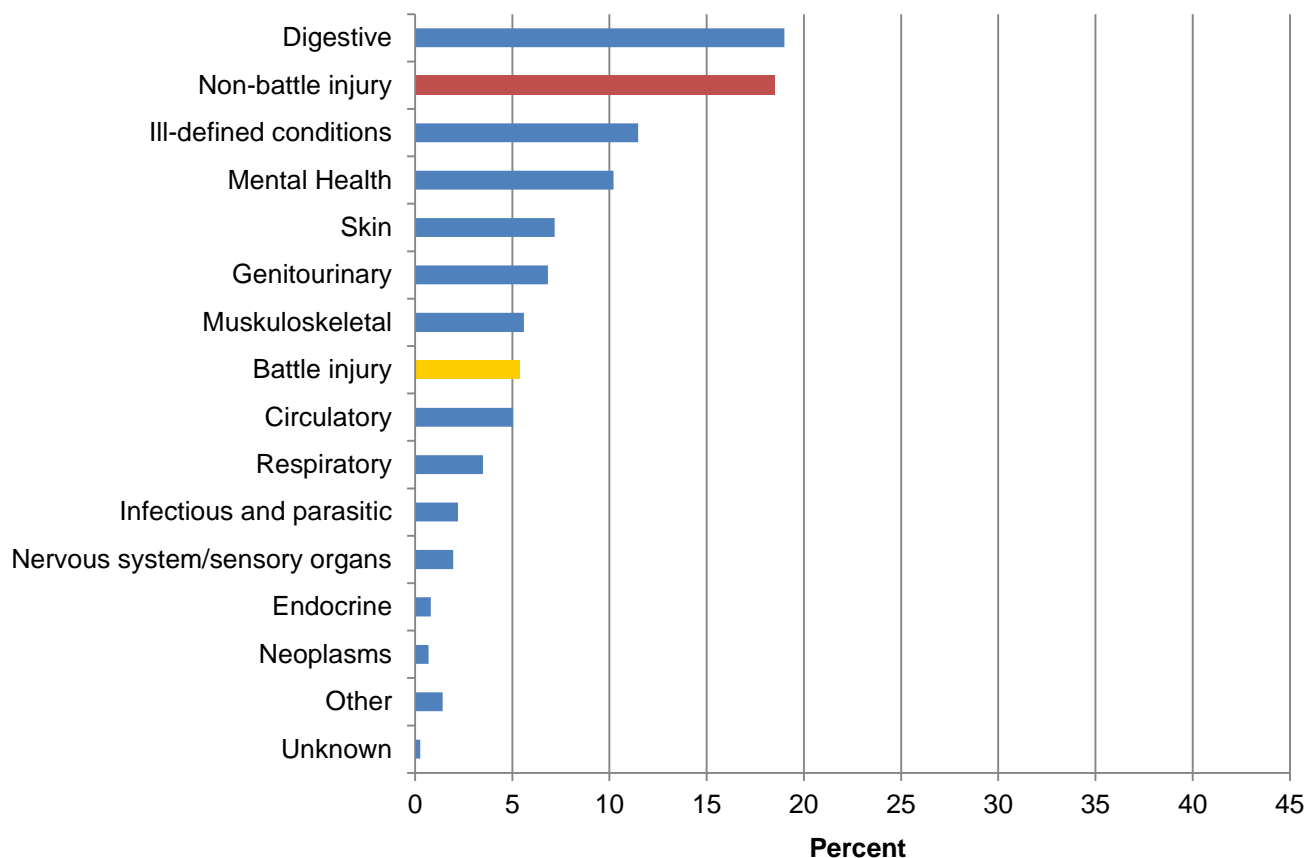
Figure 2. Distribution Percentage (%) of Injury and Disease by Diagnosis Category among Air-evacuated U.S. Army Soldiers, OEF, CY 2010

(a) In CY 2010, 3,397 Soldiers were medically air-evacuated from OEF to out-of-CENTCOM medical facilities.

(b) Non-battle injuries accounted for 30.7 percent (n=979) of these OEF air evacuations. This amount is nearly three times greater than that of the leading disease diagnosis group, “mental health,” 10.7 percent (n=365).

(c) Battle injury was the second leading category of OEF air evacuations (n=832, 24.5 percent). More Soldiers with battle injuries, and a larger proportion of the total ( $p<.001$ ), were air-evacuated from OEF than from OIF/OND in CY 2010.

(3) In-theater inpatient hospitalization distribution, OIF/OND. Figure 3 shows the percentage of injuries and disease by primary diagnosis groups (ICD-9-CM code) for OIF/OND in-CENTCOM hospitalizations in CY 2010.



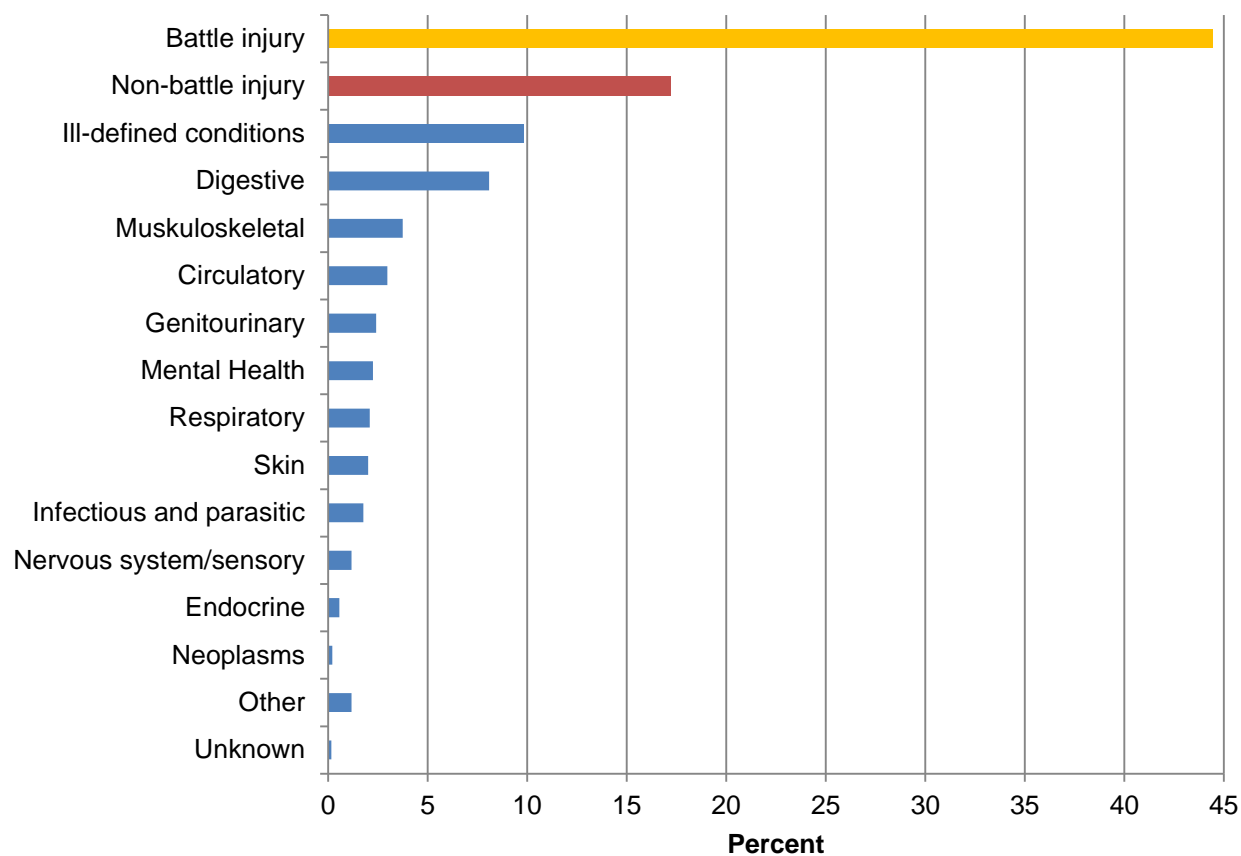
Note: Includes injury and disease resulting in in-CENTCOM hospitalization (N=2,600).

Figure 3. Distribution Percentage (%) of Injury and Disease by Diagnosis Category among Hospitalized U.S. Army Soldiers, OIF/OND, CY 2010

(a) In 2010, 2,600 OIF/OND Soldiers were hospitalized within CENTCOM.

(b) Non-battle injury was the second leading category of OIF/OND hospitalizations (n=481, 18.5 percent). The leading disease diagnosis group was “digestive” (n=493, 19.0 percent). Battle injuries accounted for 5.4% (n=104) of in-theater hospitalizations.

(4) In-theater inpatient hospitalization distribution, OEF. Figure 4 shows the percentage of injuries and disease by primary diagnosis groups (ICD-9-CM code) for OEF in-CENTCOM hospitalizations in CY 2010.



Note: Includes injury and disease resulting in in-CENTCOM hospitalization (N=2,488).

Figure 4. Distribution Percentage (%) of Injury and Disease by Diagnosis Category among Hospitalized U.S. Army Soldiers, OEF, CY 2010

(a) In CY 2010, there were 2,488 OEF in-CENTCOM hospitalizations.

(b) The combined BIs (44.4 percent) and NBIs (17.2 percent) accounted for 61.6 percent (n=1,533) of these hospitalizations. The leading specific disease category was Digestive disease (8 percent (n=201)).



(c) A significantly greater proportion of BI hospitalizations ( $p<.001$ ) occurred in OEF than in OIF/OND. In contrast, a significantly greater proportion of mental and digestive disease hospitalizations occurred in OIF/OND than in OEF (both  $p<.001$ ). The proportion of NBIs was not significantly different.

(5) Air evacuations, hospitalizations, and deaths, OIF/OND. Table 1 summarizes OIF/OND deployment injury and disease casualties in CY 2010.

Table 1. Battle Injury, Non-battle Injury, and Disease<sup>1</sup> among U.S. Army Soldiers Deployed for OIF/OND, CY 2010

	Battle Injury		Non-Battle Injury <sup>2</sup>		Disease	
	Number (n)	Row Percent (%)	Number (n)	Row Percent (%)	Number (n)	Row Percent (%)
<b>Air Evacuations (n=3103)</b>	107	3.4	1,078	34.8	1,918	61.8
<b>Hospitalizations (n=2600)</b>	140	5.4	481	18.5	1,979	76.1
<b>Deaths (n=58)</b>	20	34.5	32	55.2	6	10.3

Notes:

<sup>1</sup>Air evacuation, hospitalization, and death categories are not mutually exclusive.

<sup>2</sup>Includes acute injuries and injury-related musculoskeletal conditions.

(a) For every 1 deployment NBI death in OIF/OND in 2010, there were 15 NBI hospitalizations and 34 NBI medical air evacuations.

(b) Conservatively assuming no overlap among BI air evacuations ( $n=107$ ), hospitalizations ( $n=140$ ), and deaths ( $n=20$ ), at least 40 percent of these BIs (total  $n=267$ ) resulted in out-of-CENTCOM air evacuations, 52 percent in in-theater hospitalizations, and 8 percent in deaths.

(c) Injury fatalities have been a major focus of injury prevention efforts in the past. However, as shown by these data, there are far more non-fatal injuries that result in medical-air evacuation or hospitalization than there are fatal injuries.

(d) The ratio of disease to injury was 3:2 for air evacuations out of OIF/OND, 3:1 for in-theater hospitalization, and 1:9 for fatalities.

(6) Air evacuations, hospitalizations, and deaths, OEF. Table 2 summarizes OEF deployment injury and disease casualties in CY 2010.

Table 2. Battle Injury, Non-battle Injury, and Disease<sup>1</sup> among U.S. Army Soldiers Deployed for OEF, CY 2010

	Battle Injury		Non-Battle Injury <sup>2</sup>		Disease	
	Number (n)	Row Percent (%)	Number (n)	Row Percent (%)	Number (n)	Row Percent (%)
<b>Air Evacuations (n=3397)</b>	832	24.5	979	28.8	1,586	46.7
<b>Hospitalizations (n=2488)</b>	1,105	44.4	428	17.2	955	38.4
<b>Deaths (n=300)</b>	262	87.3	34	11.3	4	1.3

Notes:

<sup>1</sup>Air evacuation, hospitalization, and death categories are not mutually exclusive.

<sup>2</sup>Includes acute injuries and injury-related musculoskeletal conditions.

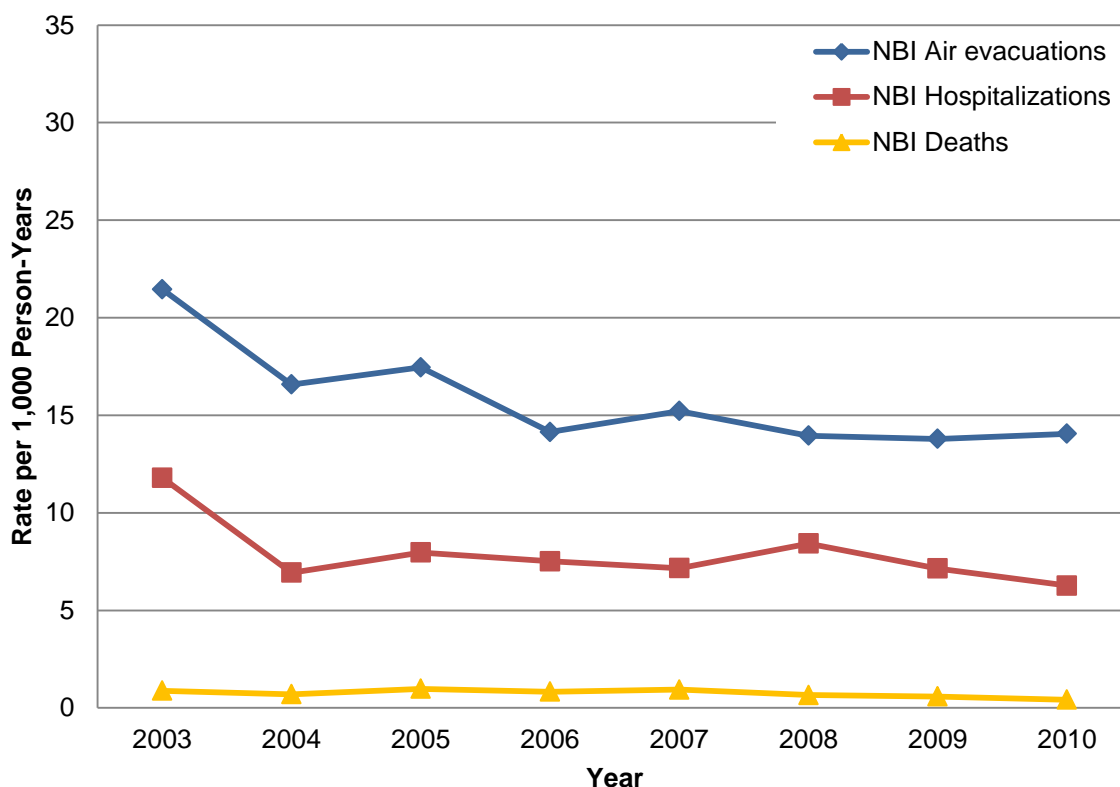
(a) For every 1 deployment NBI death in OEF in 2010, there were 13 NBI hospitalizations and 29 NBI medical air evacuations.

(b) Conservatively assuming no overlap among BI air evacuations (n=832), hospitalizations (n=1,105), and deaths (n=262), at least 39 percent of these BIs (total n=2,199) resulted in out-of-CENTCOM air evacuations, 50 percent in in-theater hospitalization, and 11 percent in death.

(c) These data show that in OEF during CY 2010, there were far more non-fatal injuries that resulted in medical-air evacuation or hospitalization than there were fatal injuries. These non-fatal outcomes result in significant lost duty time and decreased operational readiness for the Army.

(d) The ratio of disease to injury was 7:8 for air evacuations out of OIF/OND, 5:8 for in-theater hospitalization, and 1:74 for fatalities.

(7) Non-battle injury rates, OIF/OND. Figure 5 illustrates the OIF/OND NBI rates for air evacuations, hospitalizations, and deaths from 2003 to 2010.



Note: Denominators for the rates were unclassified data obtained from the Joint Chiefs of Staff, Manpower and Personnel Directorate.

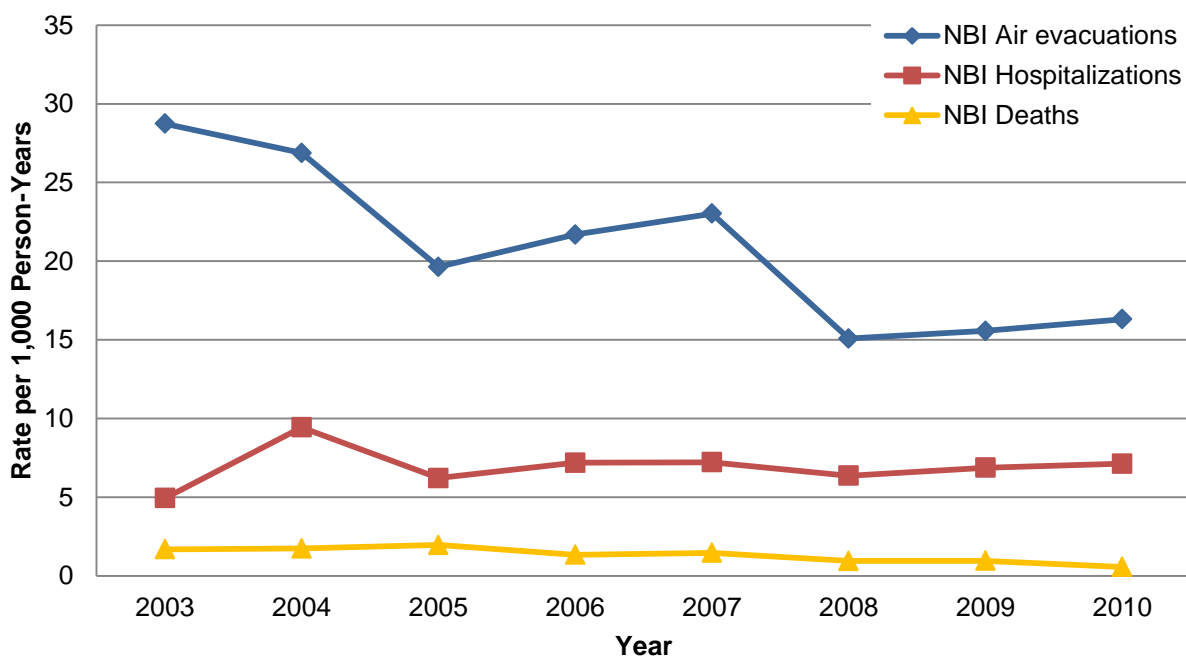
Figure 5. Non-battle Injury Rates among U.S. Army Soldiers Deployed for OIF/OND, CY 2003–2010

(a) During this time period, the OIF/OND NBI air evacuation rates decreased from 22/1,000 person-years to 14/1,000 person-years.

(b) Since 2004, the OIF/OND NBI hospitalization rates remained relatively constant at 7-9/1,000. In CY 2010, the rate fell to 6/1,000 person-years.

(c) The OIF/OND NBI death rates remained constant over the period, consistently less than 1 death per 1,000 person-years.

(8) Non-battle injury rates, OEF. Figure 6 illustrates the OEF NBI rates for air evacuations, hospitalizations, and deaths from 2003 to 2010.



Note: Denominators for the rates were unclassified data obtained from the Joint Chiefs of Staff, Manpower and Personnel Directorate.

Figure 6. Non-battle Injury Rates among U.S. Army Soldiers Deployed for OEF, CY 2003–2010

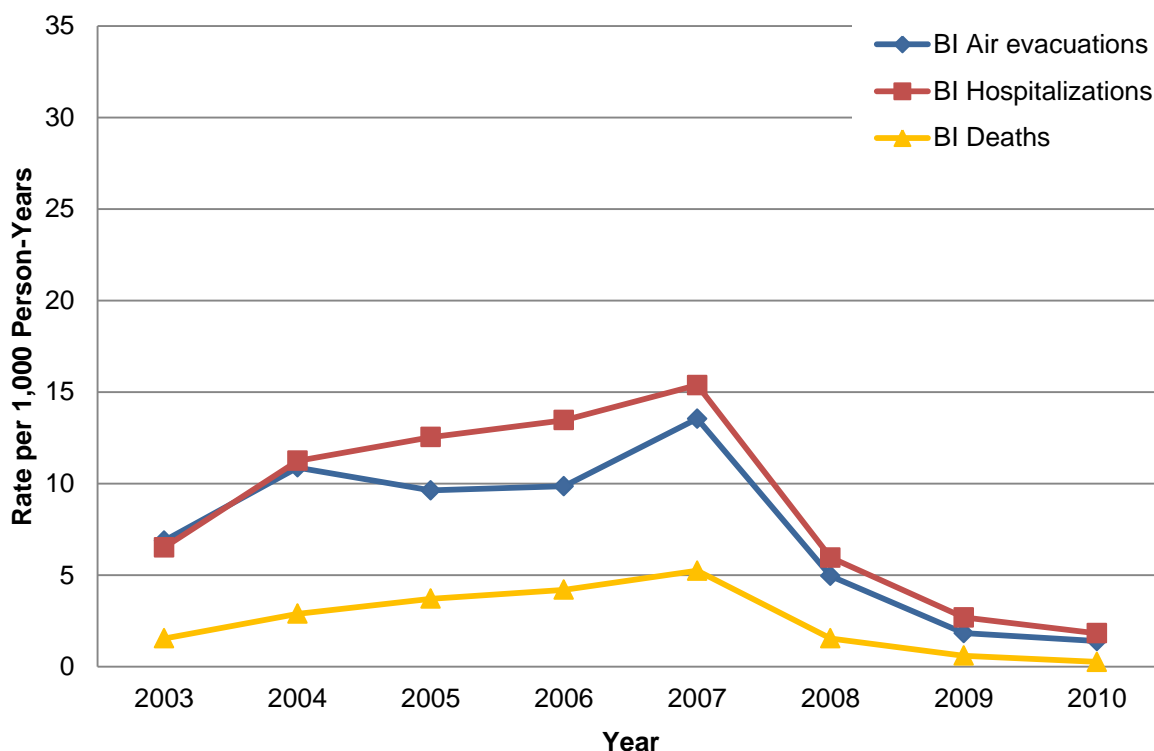
(a) Aside from slight increases in 2006 and 2007, the OEF NBI air evacuation rates decreased from 28/1,000 person-years to 16/1,000 person-years between 2003 and 2010. There was a small increase from 2009 to 2010.

(b) From 2005 to 2010, the OEF NBI hospitalization rates remained relatively constant at 6 to 7 per 1,000 person-years. Again, a slight increase from 2009 to 2010 was noted.

(c) The OEF NBI death rates remained consistently less than 2 deaths per 1,000 persons per year, showing a decreasing trend since 2005.

(d) Similar trends in air evacuation and hospitalization injury rates are seen in OIF/OND and OEF.

(9) Battle injury rates, OIF/OND. Figure 7 illustrates the OIF/OND BI rates for air evacuations, hospitalizations, and deaths from 2003 to 2010.



Note: Denominators for the rates were unclassified data obtained from the Joint Chiefs of Staff, Manpower and Personnel Directorate.

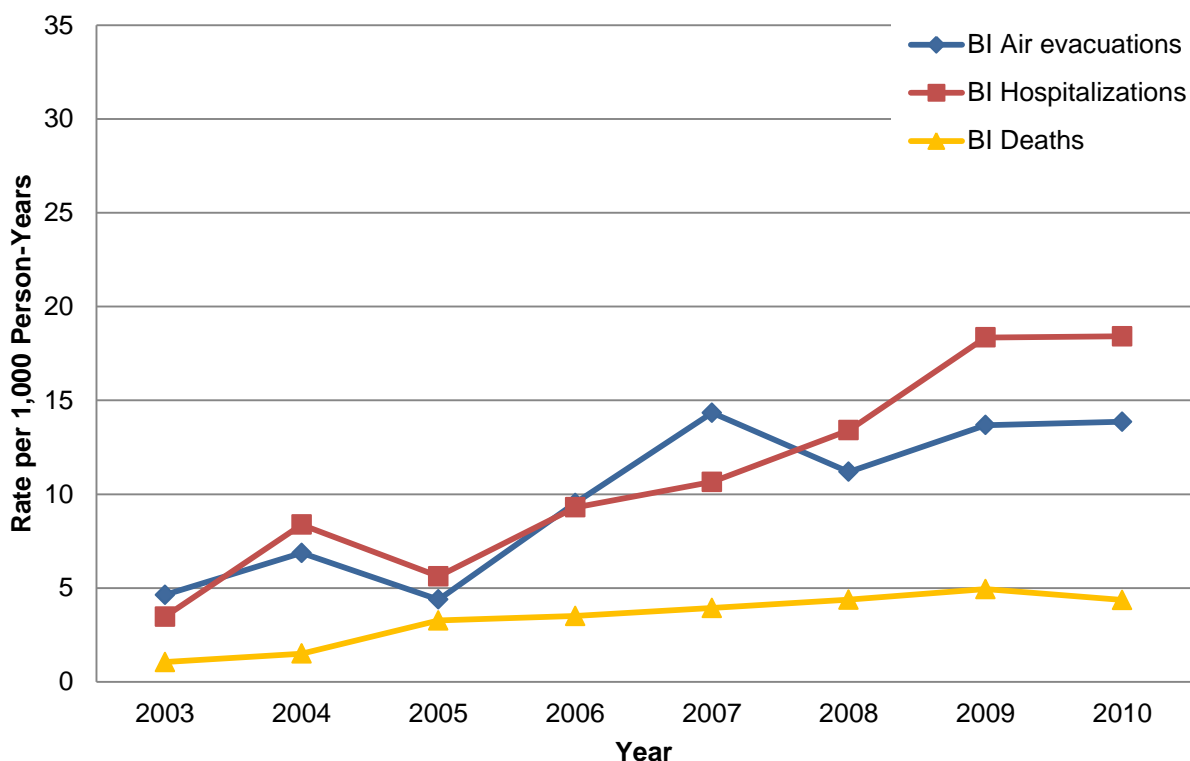
Figure 7. Battle Injury Rates (Air Evacuations, Hospitalizations, and Deaths) among U.S. Army Soldiers Deployed for OIF/OND, CY 2003-2010

(a) The OIF/OND BI air evacuation, hospitalization, and death rates increased from 2003 to 2007 and decreased thereafter.

(b) The OIF/OND BI deaths peaked at 5 deaths per 1,000 persons per year in 2007.

(c) There were 3 times as many air evacuations for BI as deaths and 4 times as many for hospitalizations.

(10) Battle injury rates, OEF. Figure 8 illustrates the OEF BI rates for air evacuations, hospitalizations, and deaths from 2003 to 2010.



Note: Denominators for the rates were unclassified data obtained from the Joint Chiefs of Staff, Manpower and Personnel Directorate.

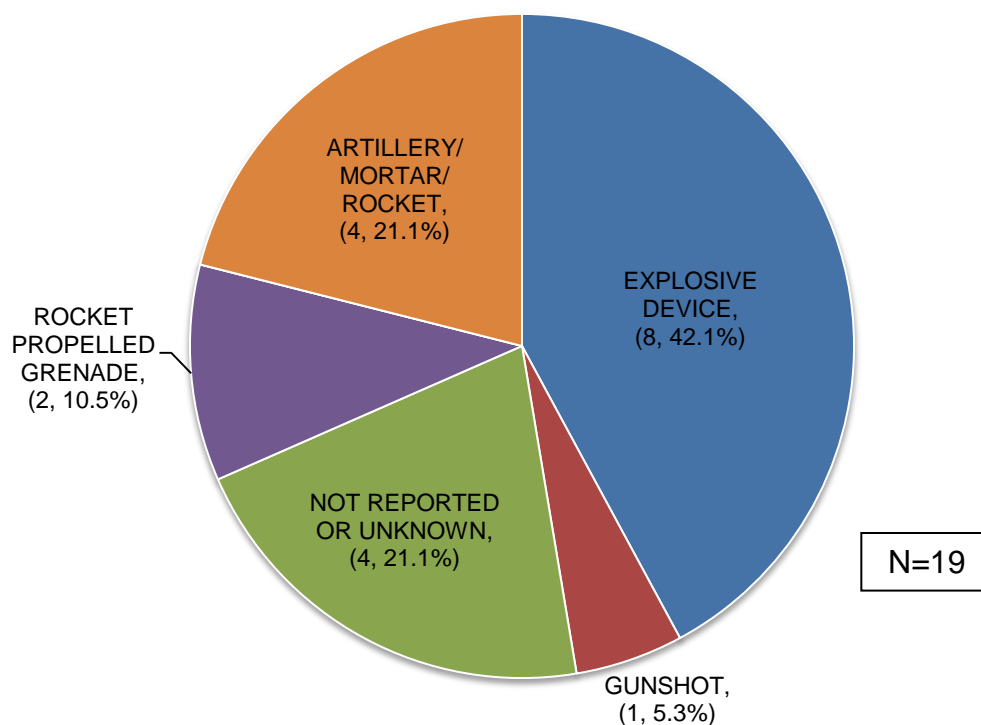
Figure 8. Battle Injury Rates (Air Evacuations, Hospitalizations, and Deaths) among U.S. Army Soldiers Deployed for OEF, CY 2003–2010

(a) The OEF BI air evacuation and hospitalization rates increased since 2005 but remained constant from 2009 to 2010.

(b) The OEF BI death rates increased steadily from 2003 to 2009, before decreasing slightly to 4 deaths per 1,000 persons per year in 2010.

(c) There were 3 times as many BI air evacuations and hospitalizations as deaths.

(11) Causes of battle injury death, OIF/OND CY 2010. Figure 9 illustrates the causes of OIF/OND Army battle injury deaths in CY 2010.

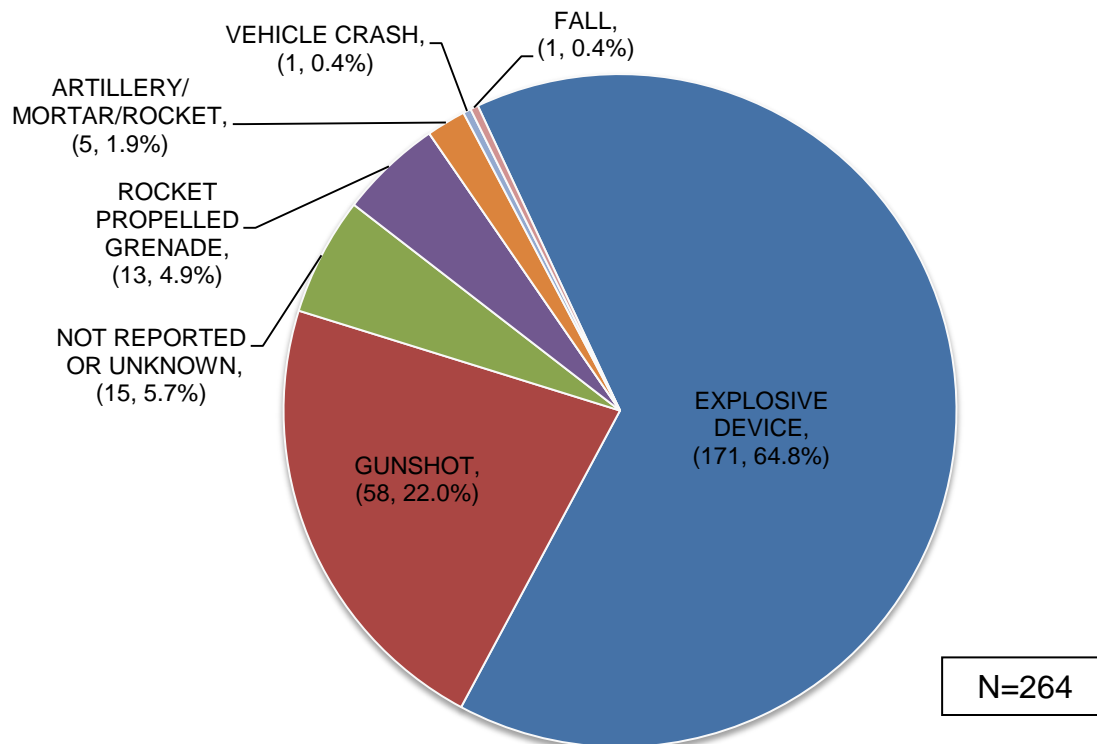


Note: Data obtained from Defense Manpower Data Center (DMDC).

Figure 9. Distribution of Causes of Battle Injury Deaths (n, percent) among U.S. Army Soldiers Deployed for OIF/OND, CY 2010

- (a) Forty-two percent of battle fatalities were due to explosive devices.
- (b) Twenty-one percent of battle fatalities were due to rocket-propelled grenades.
- (c) Ten percent of battle fatalities were due to artillery, mortar, or rockets.
- (d) Five percent of battle fatalities were due to gunshots.

(12) Causes of battle injury death, OEF CY 2010. Figure 10 illustrates the causes of OEF Army battle injury deaths in CY 2010.



Note: Data obtained from Defense Manpower Data Center (DMDC).

Figure 10. Distribution of Causes of Battle Injury Deaths (n, percent) among U.S. Army Soldiers Deployed for OEF, CY 2010

- (a) Sixty-five percent of battle fatalities were due to explosive devices.
- (b) Twenty-two percent of battle fatalities were due to gunshots.
- (c) Five percent of battle fatalities were due to rocket-propelled grenades.
- (d) Two percent of battle fatalities were due to artillery, mortar, or rockets.



(13) Injury intention for NBI hospitalizations, air evacuations, and deaths, OIF/OND and OEF, CY 2010. Table 3 provides a summary of CY 2010 OIF/OND and OEF non-battle injuries by injury intention.

Table 3. Injury Intention for Non-battle Injuries, OIF/OND and OEF, CY 2010

Injury Intention	OIF/OND						OEF					
	Air Evacuations		Hospitalizations		Deaths		Air Evacuations		Hospitalizations		Deaths	
	n	%	n	%	n	%	n	%	n	%	n	%
Intentional												
Inflicted by another	8	0.7	8	1.7	3	9.4	2	0.2	1	0.2	2	5.9
Self-inflicted	11	1.0	17	3.5	12	37.5	3	0.3	14	3.3	12	35.3
Unintentional	1,059	98.2	445	92.5	17	53.1	971	99.2	400	93.5	18	52.9
Unknown	0	0.0	11	2.3	0	0.0	2	0.2	13	3	2	5.9
<b>TOTAL</b>	<b>1,078</b>	<b>100.0</b>	<b>481</b>	<b>100</b>	<b>32</b>	<b>100.0</b>	<b>978</b>	<b>100.0</b>	<b>428</b>	<b>100</b>	<b>34</b>	<b>100.0</b>

Note: Intention of injury was determined by the STANAG 2050 trauma code.

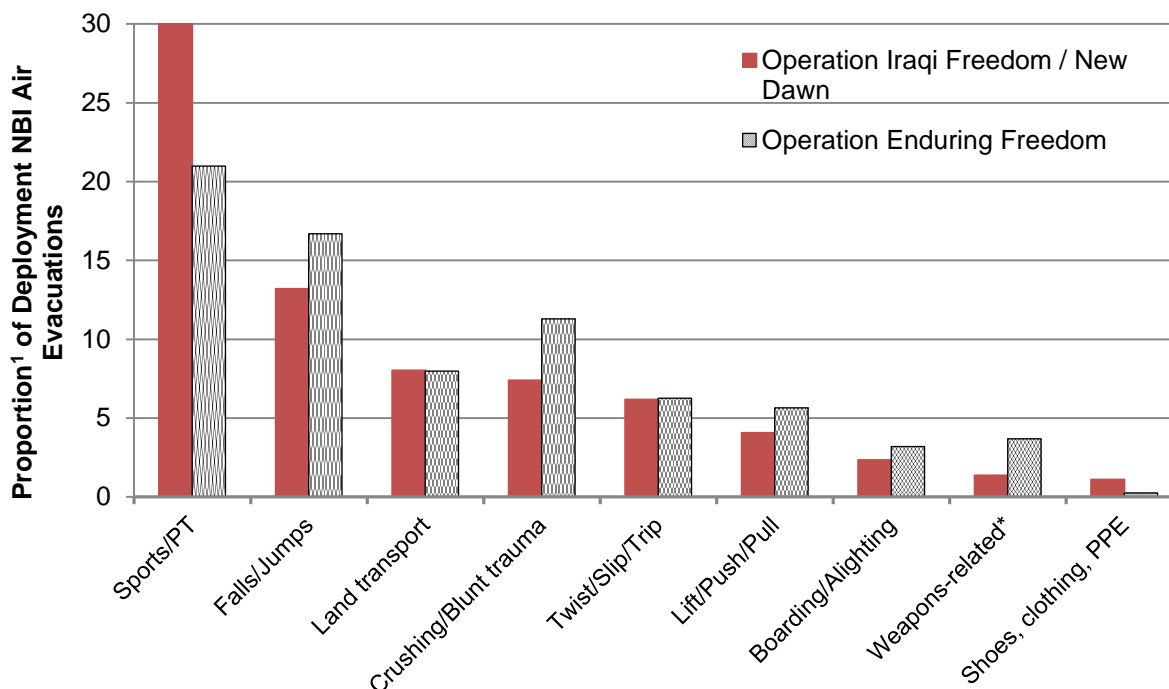
(a) The majority of NBI hospitalizations and air evacuations resulted from unintentional injuries. Unintentional non-battle injuries accounted for the largest proportion of NBI deaths.

(b) Of the self-inflicted NBIs resulting in death (n=24), 92 percent were the result of a weapon-related incident.

(c) Of the self-inflicted NBIs resulting in hospitalization (n=31), 77 percent were caused by toxic substances, 7 percent were cutting-related incidents, 7 percent were weapon-related incidents, and 9 percent resulted from other specified causes.

(d) Of the self-inflicted NBIs resulting in air evacuations (n=14), 57 percent were caused by toxic substances, and 43 percent were weapon-related.

(14) Causes of non-battle injury air evacuations. Figure 11 illustrates the distribution of the leading NBI causes of air evacuation, categorized by STANAG 2050 injury cause code groups.



Notes:

<sup>1</sup>Proportion of total 2010 deployment NBI air evacuations with a known cause for each operation (OIF/OND: N=811; OEF: N=815).

\* "Weapons-related" injuries were referred to as "own weapon" and "handling weapons/explosives" in previous reports.

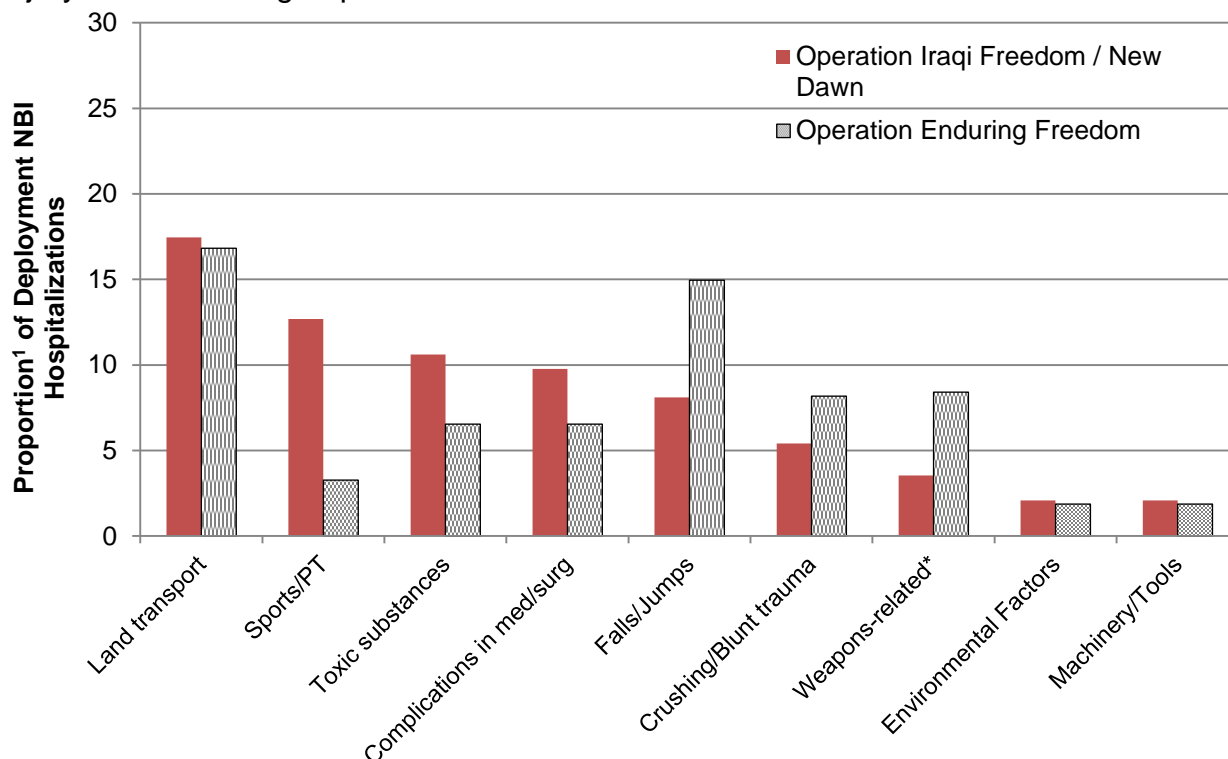
Figure 11. Distribution of Leading Causes<sup>1</sup> of Non-battle Injury Air Evacuations among U.S. Army Soldiers Deployed for OIF/OND and OEF, CY 2010

(a) In 2010, the cause of injury was identified for 1,626 of the NBIs reported for OIF/OND and OEF air evacuations (79 percent of the total NBI air evacuations).

(b) The four leading causes of NBI air evacuations for both OIF/OND and OEF were sports/physical training, falls/jumps, land transport, and crushing/blunt trauma.

(c) For OIF/OND and OEF combined, the leading causes of sports-related NBIs were physical training (21 percent), weightlifting (20 percent), basketball (19 percent), and football (15 percent). (These data are not shown in the figure.)

(15) Causes for non-battle injury hospitalizations. Figure 12 illustrates the distribution of the leading NBI causes for hospitalization, categorized by STANAG 2050 injury causes code groups.



Notes:

<sup>1</sup>Proportion of total 2010 deployment NBI hospitalizations for each operation (OIF/OND: N=481; OEF: N=428).

\* "Weapons-related" injuries were referred to as "own weapon" and "handling weapons/explosives" in previous reports.

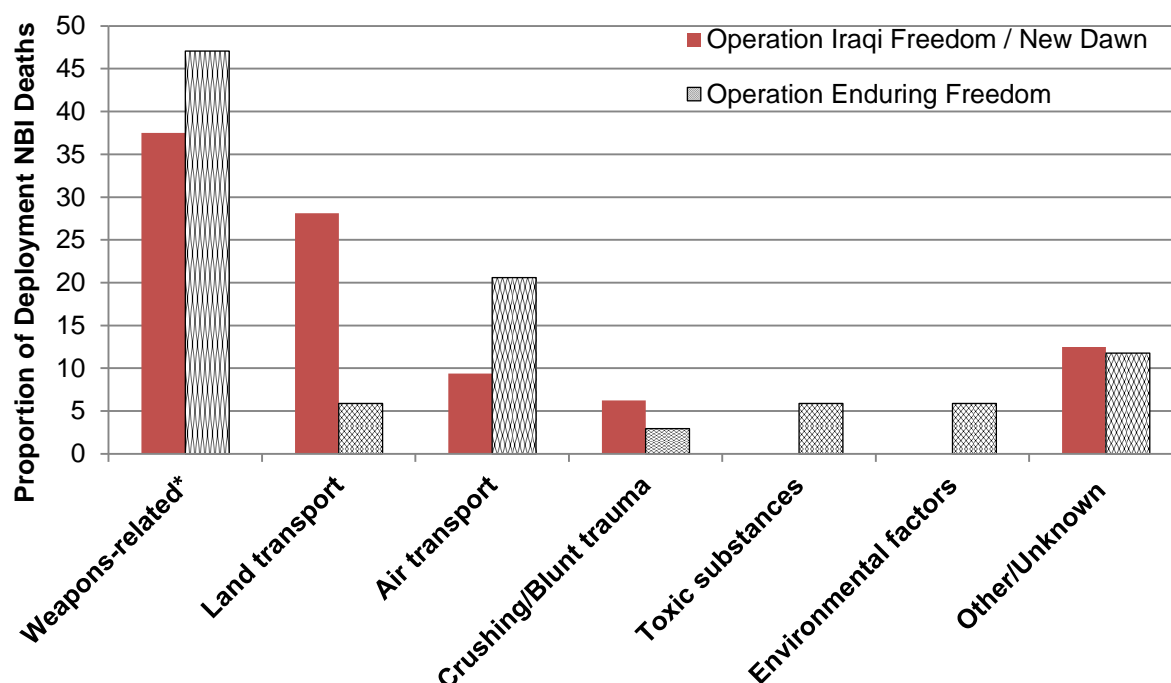
Figure 12. Distribution of Leading Causes of Non-battle Injury Hospitalizations among U.S. Army Soldiers Deployed for OIF/OND and OEF, CY 2010

(a) The three leading causes of NBI hospitalization for OIF/OND were land transport (17.5 percent), sports/physical training (12.7 percent), and toxic substances (10.6 percent); the three leading causes for OEF were land transport (16.8 percent), falls/jumps (15.0 percent), and weapons-related (8.4 percent).

(b) For OIF/OND and OEF combined, 30 percent of the toxic substance cases (poisonings) were intentionally self-inflicted.

(c) The causes of hospitalization that differed most in percentage between OIF/OND and OEF were falls/jumps ( $p < .01$ ) and sports/physical training ( $p < .01$ ).

(16) Causes of non-battle injury deaths. Figure 13 illustrates the distribution of the leading NBI causes of death, categorized by STANAG 2050 injury causes code groups as a proportion of total NBI deaths.



Notes:

<sup>1</sup>Deaths for cause of injury coding were obtained from DCIPS (OIF/OND: N=32; OEF: N=34).

\* "Weapons-related" injuries were referred to as "own weapon" and "handling weapons/explosives" in previous reports.

Figure 13. Distribution of Leading Causes of Non-battle Injury Deaths<sup>1</sup> among U.S. Army Soldiers Deployed for OIF/OND and OEF, CY 2010

(a) The three leading causes of death for OIF/OND were weapons-related (38 percent), land transport (28 percent), and air transport (9 percent), while the three leading causes for OEF were weapons-related (47 percent), air transport (21 percent), and land transport (6 percent).

(b) "Weapons-related" injury was the leading cause of NBI deaths for OIF/OND and OEF. For OIF/OND and OEF combined, 79 percent of "weapons-related" deaths were intentionally self-inflicted (n=22), 14 percent were intentionally inflicted by another (n=4), and 7 percent were accidental.

(c) Transport-related injuries (air and land transport accidents) were the second and third leading cause of NBI deaths for OIF/OND and OEF.

(17) Frequency of non-battle injury air evacuations by type and location of injury. Table 4 uses the Barell injury matrix to categorize, by type of injury and body region, the traumatic NBIs that required medical air evacuation from OIF/OND and OEF in CY 2010.

# Injury Prevention Report No. S.0000614-10

Table 4. Frequency of Air-evacuated Traumatic Non-battle Injuries by Type and Location of Injury, U.S. Army, OIF/OND and OEF, CY 2010

			Fracture	Dislocation	Sprains/ Strains	Internal	Open Wound	Amputations	Blood Vessel	Contusion/ Superficial	Crush	Burns	Nerves	Unspecified	System-wide & late effects	Total	Percent	Percent by Body Region	
Head and Neck	Traumatic Brain Injury (TBI)	Type 1 TBI	1			28							0			29	2.6	5.2	
		Type 2 TBI	4			26										30	2.6		
		Type 3 TBI	0													0	0.0		
	Other Head, Face, Neck	Other head					1						0	10			11	1.0	4.2
		Face	21	2	0		2						4				29	2.6	
		Eye					1			3			1	0			5	0.4	
		Neck	0		0		0				0	0	1				1	0.1	
Head, Face, Neck Unspec.								1	0	0	1	0	0			2	0.2		
Spine and Back	Spinal Cord (SCI)	Cervical SCI	2			1											3	0.3	0.6
		Thoracic/Dorsal SCI	0			0											0	0.0	
		Lumbar SCI	2			1											3	0.3	
		Sacrum Coccyx SCI	0			1											1	0.1	
		Spine, Back Unspec. SCI	0			0											0	0.0	
	Vertebral Column (VCI)	Cervical VCI	7	1	7												15	1.3	3.3
		Thoracic/Dorsal VCI	2	1	0												3	0.3	
		Lumbar VCI	8	0	7												15	1.3	
		Sacrum Coccyx VCI	2	0	0												2	0.2	
Spine, Back Unspec. VC		3	0													3	0.3		
Torso	Torso	Chest (thorax)	4	0	1	8	1		0	2	0	0	0				16	1.4	3.4
		Abdomen				3	2		0	0		0	2				7	0.6	
		Pelvis, Urogenital	3	0	4	0	1		0	0	1	0	0				9	0.8	
		Trunk	0				0			2	0	0	0	3			5	0.4	
		Back, Buttock			1		0			0	1	0					2	0.2	
Extremities	Upper	Shoulder, Upper Arm	29	53	68		1	0		1	0	0		4			156	13.7	39.0
		Forearm, Elbow	59	4	4		2	0		0	0	0					69	6.1	
		Wrist, Hand, Fingers	110	11	17		32	14		6	2	2		11			205	18.0	
		Other & Unspec.	0				0	0	2	0	0	0	10	1			13	1.1	
	Lower	Hip	1	1	12					1	0						15	1.3	38.8
		Upper leg, Thigh	13					0		0	1	1					15	1.3	
		Knee	7	108	42					1	1	1					160	14.1	
		Lower leg, Ankle	112	5	20			0		0	1	1					139	12.2	
		Foot, toes	45	6	2		2	1		3	2	0					61	5.4	
Other & Unspec.		0		26		9	0	1	2	0	1		12			51	4.5		
Unclass. by Site	Other, Unspecified	Other/Multiple	0						0			0	4			4	0.4	3.4	
		Unspec. Site	16	5	5	0	0		0	2	1	2	3	1		35	3.1		
	System-wide & late effects															23	23	2.0	2.0
		Total	451	197	216	68	54	15	4	23	10	14	20	42	23	1137		100.0	100.0
		Percent	39.7	17.3	19.0	6.0	4.7	1.3	0.4	2.0	0.9	1.2	1.8	3.7	2.0				

Note: ICD-9-CM 800-995 codes. Includes the first listed injury diagnosis for injuries resulting in out-of-CENTCOM air evacuation.

(a) In 2010, 1,137 acute/traumatic NBIs (coded in the 800-995 ICD-9-CM code series) required medical air evacuation.

(b) The most common types of injury leading to medical air evacuation were fractures (40 percent), sprains/strains (19 percent), and dislocations (17 percent).

(c) By body region, the injury sites most commonly leading to medical air evacuation were the upper extremities (39 percent), lower extremities (39 percent), and head, face, and neck (9 percent).

(d) The leading specific reasons for medical air evacuation included fractures of the lower leg and/or ankle (10 percent), fractures of the wrist, hand, or fingers (10 percent), dislocations of the knee (9 percent), and strain/sprain of the shoulder/upper arm (6 percent).

(18) Frequency of non-battle musculoskeletal injury air evacuations by type and location of injury. Table 5 categorizes, by type of injury and body region, the NBI-related musculoskeletal conditions (a subset of musculoskeletal conditions coded in the 719-739 ICD-9-CM series) that required medical air evacuation from OIF/OND and OEF in CY 2010.

Injury Prevention Report No. S.0000614-10

Table 5. Frequency of Air-evacuated Non-battle Injury-related Musculoskeletal Conditions by Type and Location of Injury, U.S. Army, OIF/OND and OEF, CY 2010

			Inflammation and Pain (Overuse)	Joint Derangement	Joint Derangement with Neurological	Stress Fracture	Sprains/Strains/ Rupture	Dislocation	Total	Percent	Percent by Body Region	
Spine and Back	Vertebral Column (VCI)	Cervical VCI	35	10	15				60	9.1	47.1	
		Thoracic/Dorsal VCI		0	17				17	2.6		
		Lumbar VCI	2	16	142				160	24.4		
		Sacrum Coccyx VCI	27						27	4.1		
		Spine, Back Unspec. VCI	35	6	4	0			45	6.9		
Extremities	Upper	Shoulder	52	15			26	4	97	14.8	16.9	
		Upper Arm, Elbow	4	1		0		0	5	0.8		
		Forearm, Wrist	5	0		0		0	5	0.8		
		Hand	0	0			4	0	4	0.6		
	Lower	Pelvis, Hip, Thigh	15	0		0	4	0	19	2.9	26.1	
		Lower leg, Knee	40	36		4	47	0	127	19.4		
		Ankle, Foot	20	3		2	0	0	25	3.8		
Unclass. by Site	Other, Unspecified	Other specified/Multiple	2	1		0	2	0	5	0.8	9.9	
		Unspecified Site	15	2	18	8	17	0	60	9.1		
		Total	252	90	196	14	100	4	656			
		Percent	38.4	13.7	29.9	2.1	15.2	0.6		100.0	100.0	

Note: ICD-9-CM 710-739 codes. Includes the first listed injury diagnosis for injuries resulting in out-of-CENTCOM air evacuation.



(a) In 2010, 656 NBI-related musculoskeletal conditions required medical air evacuation.

(b) The most common types of musculoskeletal conditions leading to medical air evacuation were inflammation and pain (overuse) (38 percent), joint derangement with neurological involvement (30 percent), sprain/strain/rupture of muscle or tendons (15 percent), and joint derangement (14 percent),

(c) At 47 percent, the spine/back was the body region most affected by injury-related musculoskeletal conditions, followed by the lower extremities (26 percent), and upper extremities (17 percent).

(d) The leading specific injury-related musculoskeletal conditions were joint derangement with neurological involvement of the lumbar spine (22 percent), inflammation and pain (overuse) involving the shoulder (8 percent), and strains/sprains/rupture to the lower leg and/or knee (7 percent).

(19) Frequency of non-battle injury hospitalizations by type and location of injury. Table 6 uses the Barell injury matrix to categorize, by type of injury and body region, the traumatic NBIs that required in-theater hospitalization in OIF/OND and OEF in CY 2010.

# Injury Prevention Report No. S.0000614-10

Table 6. Frequency of Traumatic Hospitalized Non-battle Injuries by Type and Location of Injury, U.S. Army, OIF/OND and OEF, CY 2010

			Fracture	Dislo- cation	Sprains/ Strains	Internal	Open Wound	Amputa- tions	Blood Vessel	Contu- sion/Su- perficial	Crush	Burns	Nerves	Unspec- ified	System- wide & late effects	Total	Percent	Percent by Body Region	
Head and Neck	Traumatic Brain Injury (TBI)	Type 1 TBI	8			33							0			41	5.0	14.0	
		Type 2 TBI	1			69										70	8.6		
		Type 3 TBI	3													3	0.4		
	Other Head, Face, Neck	Other head					10						0	0	9		19	2.3	11.4
		Face	41	1	0		7						2				51	6.3	
		Eye					3			4			1	0			8	1.0	
		Neck	0		0		3				0	0	0				3	0.4	
Head, Face, Neck Unspec.								1	6	1	4	0	0			12	1.5		
Spine and Back	Spinal Cord (SCI)	Cervical SCI	1			2											3	0.4	0.7
		Thoracic/Dorsal SCI	1			0											1	0.1	
		Lumbar SCI	2			0											2	0.2	
		Sacrum Coccyx SCI	0			0											0	0.0	
		Spine, Back Unspec. SCI	0			0											0	0.0	
	Vertebral Column (VCI)	Cervical VCI	6	0	4												10	1.2	3.7
		Thoracic/Dorsal VCI	4	1	0												5	0.6	
		Lumbar VCI	7	0	7												14	1.7	
		Sacrum Coccyx VCI	1	0	0												1	0.1	
		Spine, Back Unspec. VC	0	0													0	0.0	
Torso	Torso	Chest (thorax)	4	0	1	5	3		0	4	4	0	0				21	2.6	5.9
		Abdomen				9	3		0	0		0	0				12	1.5	
		Pelvis, Urogenital	5	0	1	2	1		0	0	0	0	0				9	1.1	
		Trunk	0				0			2	1	1	0	2			6	0.7	
		Back, Buttock			0		0			0	0	0	0				0	0.0	
Extremities	Upper	Shoulder, Upper Arm	19	3	4		2	0		4	0	0		2			34	4.2	28.0
		Forearm, Elbow	22	1	0		8	1		0	3	1					36	4.4	
		Wrist, Hand, Fingers	72	2	4		43	9		0	12	5		3			150	18.5	
		Other & Unspec.	0				1	0	2	1	0	2	1	1			8	1.0	
	Lower	Hip	2	2	3					1	0						8	1.0	19.8
		Upper leg, Thigh	7					1		2	1	0					11	1.4	
		Knee	0	6	0					0	0	0					6	0.7	
		Lower leg, Ankle	62	1	8			0		0	2	3					76	9.3	
		Foot, toes	6	3	0		8	2		1	5	0					25	3.1	
		Other & Unspec.	0		4		21	0	4	4	0	1		1			35	4.3	
Unclass. by Site	Other, Unspecified	Other/Multiple	0						0			0	0			0	0.0	1.1	
		Unspec. Site	0	0	2	0	3		0	0	0	2	1	1		9	1.1		
	System-wide & late effects															124	124	15.3	15.3
		Total	274	20	38	120	116	13	7	29	29	22	2	19	124	813	100.0	100.0	
		Percent	33.7	2.5	4.7	14.8	14.3	1.6	0.9	3.6	3.6	2.7	0.2	2.3	15.3				

Note: ICD-9-CM 800-995 codes. Includes the first listed injury diagnosis for injuries resulting in in-CENTCOM hospitalization.

(a) In 2010, 813 NBIs (coded in the 800-995 ICD-9-CM code series) required in-theater hospitalization.

(b) The most common types of injury leading to in-theater hospitalization were fractures (34 percent), internal injuries (15 percent), and open wounds (14 percent).

(c) The injured body regions most commonly leading to in-theater hospitalization were upper extremities (28 percent), head and neck injuries (25 percent), and lower extremities (20 percent).

(d) The leading specific reasons for in-theater hospitalization included fractures of the wrist, hand, and/or fingers (12 percent), internal Type 2 traumatic brain injuries (11 percent), and fractures of the lower leg and/or ankle (8 percent).

(20) Frequency of non-battle musculoskeletal injury hospitalizations by type and location of injury. Table 7 categorizes, by type of injury and body region, the NBI-related musculoskeletal conditions (a subset of musculoskeletal conditions coded in the 719-739 ICD-9-CM series) that required in-theater hospitalization in OIF/OND and OEF in CY 2010.

Injury Prevention Report No. S.0000614-10

Table 7. Frequency of Hospitalized Non-battle Injury-related Musculoskeletal Conditions by Type and Location of Injury, U.S. Army, OIF/OND and OEF, CY 2010

			Inflammation and Pain (Overuse)	Joint Derangement	Joint Derangement with Neurological	Stress Fracture	Sprains/Strains/ Rupture	Dislocation	Total	Percent	Percent by Body Region
Spine and Back	Vertebral Column (VCI)	Cervical VCI	23	1	0				24	17.3	59.7
		Thoracic/Dorsal VCI		0	5				5	3.6	
		Lumbar VCI	0	2	34				36	25.9	
		Sacrum Coccyx VCI	5						5	3.6	
		Spine, Back Unspec. VCI	12	0	1	0			13	9.4	
Extremities	Upper	Shoulder	10	1			0	1	12	8.6	15.1
		Upper Arm, Elbow	6	1		0		0	7	5.0	
		Forearm, Wrist	1	0		0		0	1	0.7	
		Hand	0	0			0	1	1	0.7	
	Lower	Pelvis, Hip, Thigh	4	0		0	0	0	4	2.9	18.0
		Lower leg, Knee	16	1		0	3	0	20	14.4	
		Ankle, Foot	1	0		0	0	0	1	0.7	
Unclass. by Site	Other, Unspecified	Other specified/Multiple	1	0		0	0	0	1	0.7	7.2
		Unspecified Site	9	0	0	0	0	0	9	6.5	
		Total	88	6	40	0	3	2	139		
		Percent	63.3	4.3	28.8	0.0	2.2	1.4		100.0	100.0

Note: ICD-9-CM 710-739 codes. Includes the first listed injury diagnosis for injuries resulting in in-CENTCOM hospitalization.

(a) In 2010, 139 NBI-related musculoskeletal conditions required in-theater hospitalization.

(b) The most common types of musculoskeletal conditions leading to in-theater hospitalization were inflammation and pain (overuse) (63 percent), joint derangement with neurological involvement (29 percent), and joint derangement (4 percent).

(c) At 60 percent, the spine/back was the body region most affected by injury-related musculoskeletal conditions, followed by the lower extremities (18 percent), and upper extremities (15 percent).

(d) The leading specific injury-related musculoskeletal conditions were joint derangement with neurological involvement to the lumbar spine (24 percent), inflammation and pain (overuse) involving the cervical spine (16 percent), and inflammation and pain (overuse) to the lower leg and/or knee (12 percent).

d. Discussion.

(1) In CY 2010, NBI was the largest single diagnosis category that resulted in out-of-CENTCOM air evacuations for OIF/OND and OEF. Non-battle injury was second to digestive diseases for OIF/OND hospitalizations and second to battle injuries for OEF hospitalizations. The present findings are consistent with previous studies showing the relative importance of NBIs as a cause of morbidity and mortality.<sup>(1-10)</sup>

(a) In the CY 2009 deployment injury surveillance report for OIF and OEF, there were 7 times more disease and non-battle injuries (DNBIs) than battle injuries, and 37 percent of air evacuations were for non-battle injuries.

(b) For OIF/OND in CY 2010, there were 28 times more disease and non-battle injuries (DNBIs) than battle injuries, and 35 percent of air evacuations were for non-battle injuries. Non-battle injuries remained the leading cause of OIF/OND air evacuations, while BIs fell from the fourth leading cause in CY 2009 to the ninth leading cause in CY 2010.

(c) For OEF in CY 2010, there were almost three times as many DNBIs than battle injuries, and 29 percent of air evacuations were for NBIs. While the proportion of NBIs for OIF/OND hospitalizations increased from 2009, digestive disease diagnosis remains the leading cause of OIF/OND hospitalizations. Battle injuries fell three places to the eighth leading cause of hospitalizations in-theater.

(2) The annual NBI air evacuation rates for OIF/OND decreased over time from a high in 2003. The annual hospitalization rates for OIF/OND decreased from 2003 to 2004 and have remained relatively constant since that time. The annual NBI death rate for OIF/OND remained constant. Operation Enduring Freedom has experienced greater fluctuation in the rates of air evacuation and hospitalization than OIF/OND, with 2004 and 2007 being peak years. Injury rates and trends for OIF/OND and OEF were previously reported by other descriptive studies.<sup>(16,17-18)</sup> These studies showed peak rates in 2003 but did not include the 2007 time period.

(3) In this report, the leading NBI types for 2010 air evacuations were fracture, sprains/strains, dislocations, and inflammation and pain (overuse). The back was most commonly involved, followed by the knee, shoulder, and ankle/foot. In general, previous studies have focused on specific body regions or diagnosis categories when describing injury or disease type. As noted in the 2009 report, the finding of fractures as the leading NBI types for both hospitalizations and air evacuations was consistent with the burden of non-battle orthopedic injuries treated at one facility during the combat phase of OIF.<sup>(19)</sup>

(4) The U.S. Army uses surveillance data to identify cause of injury and potentially modifiable risk factors for injury to develop comprehensive injury prevention programs. This report has identified the top three causes of NBI air evacuations in 2010 as sports/physical training, falls/jumps, and crushing/blunt trauma. The top three leading causes of NBI hospitalizations, which differed from those of NBI air evacuations, were land transport-related accidents, falls/jumps, and toxic substances. The leading causes of death were weapons-related incidents (gunshot wounds), land transport-related accidents, and air transport accidents. Self-inflicted injury fatalities, which have risen from 2004 to 2008,<sup>(20)</sup> accounted for nearly all weapons-related NBI fatalities ("own weapon"). Although sports/physical training and falls/jumps continue to be leading causes of NBIs, the rates of these injuries are decreasing.

(5) The impact of injuries and the causes, type, and body region of injuries were similar from 2009 to 2010, with minor changes. In CY 2010, compared to 2009:

(a) Operation Iraqi Freedom/Operation New Dawn experienced a lower percentage of air evacuations and hospitalizations from battle injuries. The decrease in battle injuries is likely associated with the change in mission of OIF during the transition to OND.

(b) Operation Iraqi Freedom/Operation New Dawn experienced a substantial decrease in air evacuations, hospitalizations, and fatalities from 2009 to 2010.

Operation Enduring Freedom, however, had nearly twice as many medical encounters and fatalities in 2010.

(c) There was a 35 percent increase in OEF BI deaths from 2009 to 2010. The leading causes of OEF battle-related deaths were similar. However, the leading causes of BI deaths in OIF/OND changed from 2009 to 2010. A decrease in BI deaths caused by gunshot wounds was noted, as was an increase in deaths caused by artillery, mortar, or rockets. A decrease in deaths was also noted in OIF/OND.

(d) The leading body sites for injury differed only slightly for 2010 as compared to 2009. In 2010, the leading body injury sites for NBIs, in order of high to low, were the back, knee, ankle/foot, shoulder, and wrist/hand. In 2009, these sites were the back, knee, shoulder, ankle/foot, and wrist/hand.

(e) The leading causes of NBI air evacuations remained the same in 2010 as in 2009. Sports/physical training injuries remain the leading cause of NBI air evacuations but account for a greater percentage of injuries for both OIF/OND and OEF in 2010.

(f) In 2010, the top three leading causes of NBI hospitalizations remained the same; however, sports/physical training injuries surpassed toxic substances as the second leading cause. The decrease in the percentage of toxic substance hospitalizations out of all hospitalizations could be associated with the decrease in self-inflicted toxic substance (poisoning) hospitalizations from 2009 (46 percent) to 2010 (30 percent).

(g) Air transportation surpassed toxic substances as the third leading cause of NBI fatalities. The two leading causes of NBI deaths remained the same. However, a decrease in weapon-related death in both OIF and OEF was noted.

(6) Current intervention studies and strategies (civilian and military) to address deployment NBI include:

(a) Use of ankle braces (stabilizers) to reduce ankle injuries.<sup>(21-23)</sup>

(b) Ocular preventive measures such as hygiene, contact lens restriction, and protective eyewear use during participation in racquet and contact sports.<sup>(24-27)</sup>

(c) Vehicle rollover drowning prevention training, rollover simulator training, equipment modifications to prevent rollover accidents, and improved compliance for seatbelt use.<sup>(28-30)</sup>

(d) Breakaway bases, recessed bases, and proper sliding technique education for softball and baseball sliding injuries.<sup>(31)</sup>

(e) Mouthguard use in sports activities where there is significant risk of orofacial injury.<sup>(32)</sup>

e. Recommendations.

(1) Continue routine surveillance of deployment injuries and annual updates of this deployment injury surveillance report.

(2) Link additional data sources, such as levels IV and V hospitalizations and disability records, to provide an enhanced description of deployment injuries and their outcomes.

(3) Continue investigations that will identify modifiable risk factors that contribute to the leading causes of injury.

(4) Focus attention on strategies that will aid in preventing injuries from sports/physical training, falls/jumps, and land transport mishaps.

(a) Make sure surfaces for sports are level and free of hazards.

(b) Avoid overtraining.

(c) Be cautious when getting on and off vehicles and working around them to avoid falls.

(d) Wear seatbelts when tactical situation permits.



5. SPECIAL ANALYTIC DEPLOYMENT INJURY SURVEILLANCE PROJECT  
SUMMARIES, 2010.

a. Distribution and Causes of Fatal Non-battle Injuries during Operations Enduring Freedom and Iraqi Freedom, 2001-2009.

(1) During the Persian Gulf War (1990-1991), 52.2 percent of deaths among Army Soldiers were attributable to fatal NBIs.

(2) This investigation evaluated the incidence and causes of fatal NBIs among Soldiers deployed in OEF and OIF, October 2001–December 2008. Figure 14 shows the annual rate of fatal NBIs from 2001 to 2009.

(3) There were 3,494 deaths (OIF: n=3014; OEF: n=480). Of these, for OIF and OEF respectively, 19 percent (n=564) and 29 percent (n=140) were NBIs, 79 percent (n=2,393) and 69 percent (n=329) were battle injuries, and 2 percent (n=57) and 2 percent (n=11) were illness/disease.

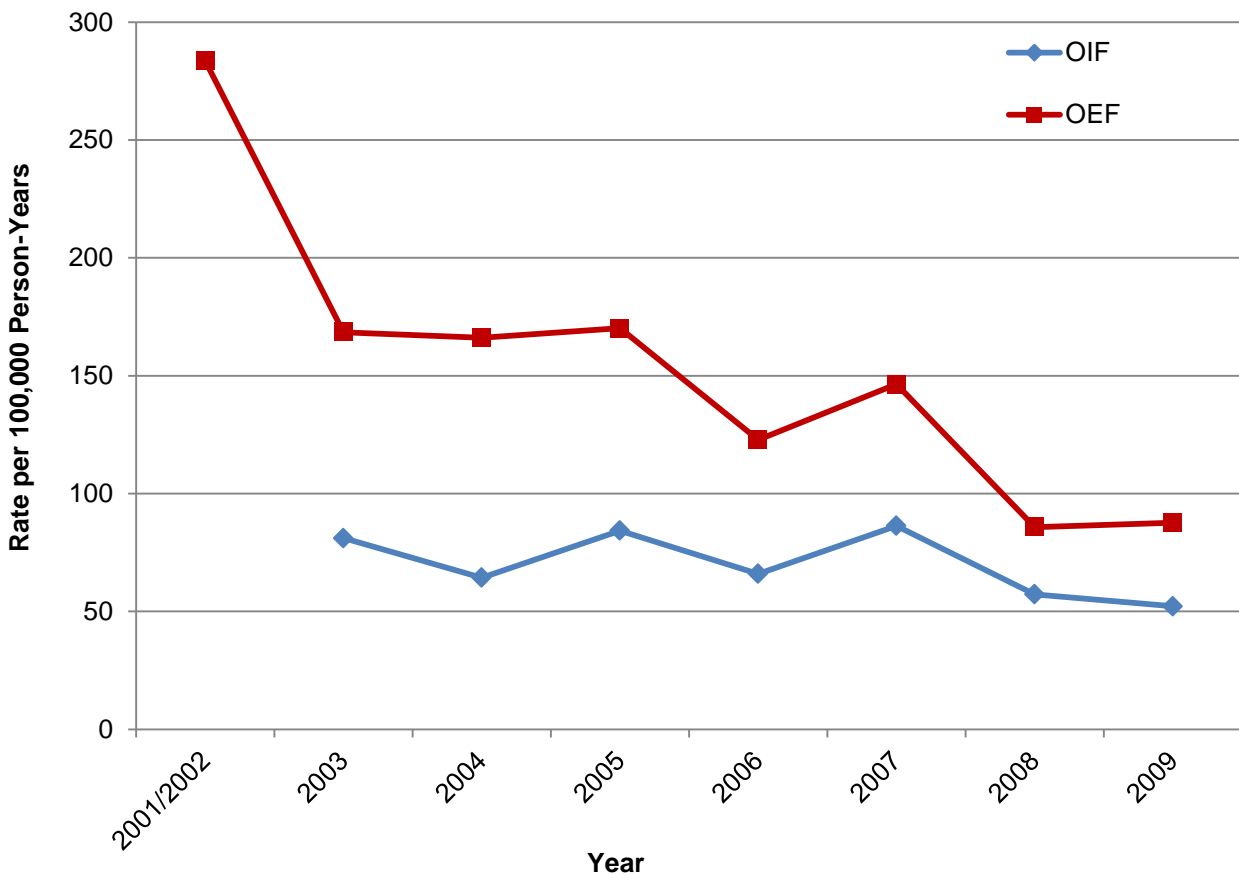


Figure 14. Annual Rate of Fatal Non-battle Injuries, CY 2001–2009

(4) The leading causes of fatal NBIs (Figure 15) were motor vehicle accidents (OIF: 40 percent; OEF: 20 percent;  $p<0.001$ ), intentionally self-inflicted injuries (OIF: 24 percent; OEF: 16 percent;  $p=0.04$ ), air transport (OIF: 12 percent; OEF: 44 percent;  $p<0.001$ ), and handling weapons (OIF: 7 percent; OEF: 11 percent;  $p=0.13$ ). There were substantial differences in the distribution of causes of fatal NBIs between OIF and OEF.

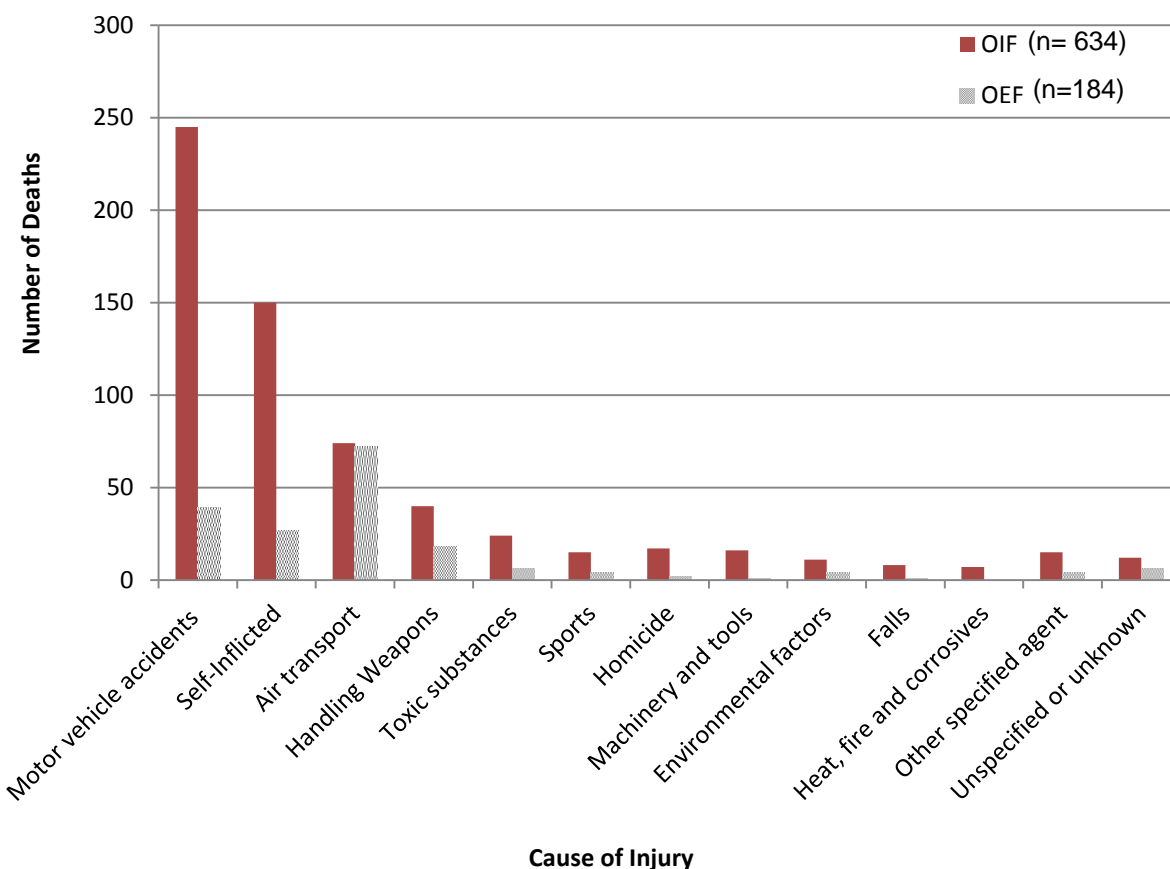


Figure 15. Causes of Fatal Non-battle Injuries, OIF/OEF, CY 2001–2009

b. Fall-related Injuries as a Leading Cause of Injury among Deployed Army Soldiers.

(1) In 2008, falls (including near falls, for example, twisting or turning an ankle without falling) were the leading cause of unintentional injury hospitalizations (18 percent) for the non-deployed Army.

(2) The purpose of this analysis was to examine and describe the incidence of serious, fall-related injuries requiring medical air evacuations of Soldiers deployed for Operations Iraqi Freedom (Iraq) and Enduring Freedom (Afghanistan) between 2001 and 2009.

(3) Figure 16 shows the leading causes of non-battle injuries air-evacuated from theater from 2001 to 2009.

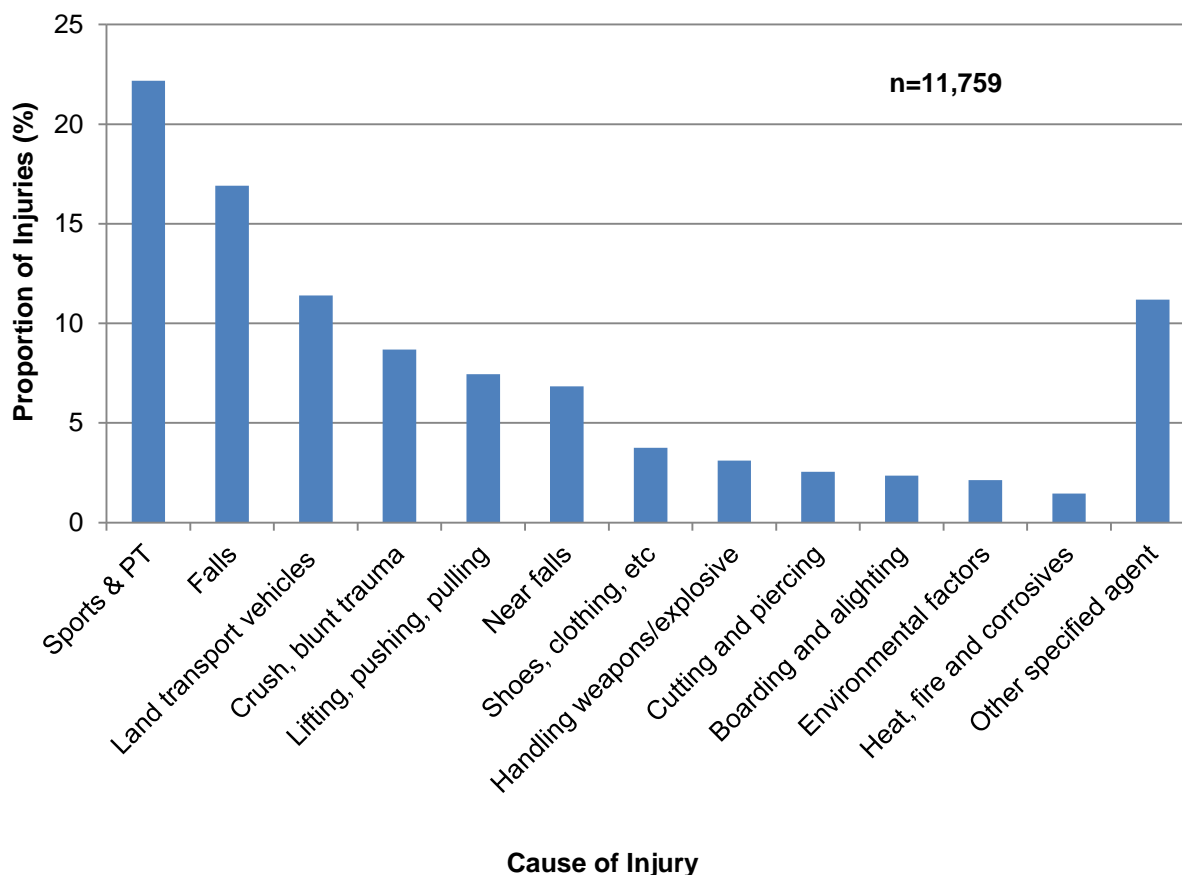


Figure 16. Primary Causes of Air-evacuated, Non-battle Injuries, Iraq and Afghanistan, CY 2001-2009.

(4) Overall, 17,534 Soldiers were air evacuated for NBIs. Of the injuries with an identifiable cause (n=11,759), falls were the second leading cause of injury, comprising 17 percent of NBIs (n=2,792; rate: 3/1,000 person-years). (See Figure 17.)

(5) The types of falls included those from one level to another (30 percent), on a single level (30 percent), alighting vehicles (10 percent), from stairs/ladder (6 percent), and near falls (24 percent). The leading fall injury types were fractures (36 percent), dislocations (19 percent), and sprains (13 percent).

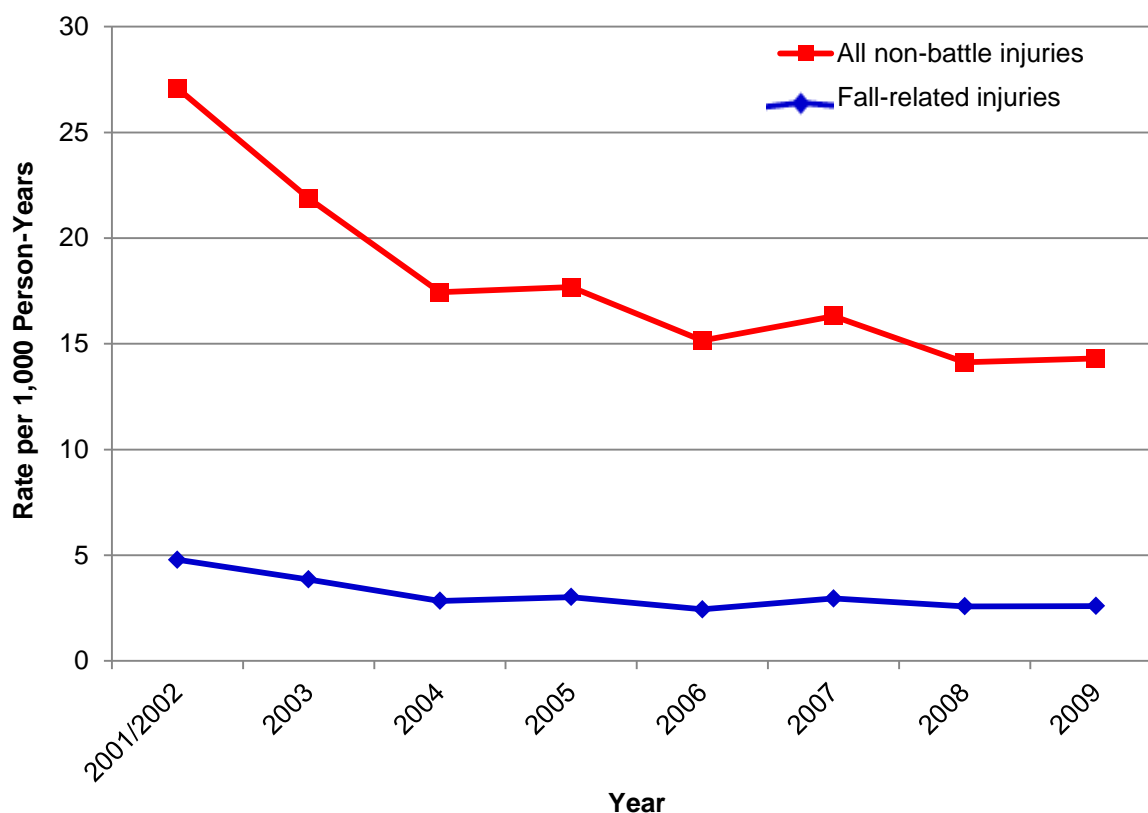


Figure 17. Annual Rate of Non-battle and Fall-related Injuries, Iraq and Afghanistan, CY 2001-2009

c. Sports Injuries among Active Service Members Deployed for OIF and OEF, 2001-2008.

(1) Participation in sports and physical exercise is a leading cause of injuries among Soldiers, resulting in significant lost duty time and decreased military readiness.

(2) The purpose of this analysis was to determine the incidence of sports- and exercise-related injuries that required medical air evacuation of service members deployed for OIF and OEF from 2001 to 2008 and to describe the distribution for injury type and anatomic location of injury.

(3) Of the 12,789 air-evacuated NBIs with an identified cause of injury, sports and physical exercise were the leading cause of NBI, accounting for 21 percent (n=2,743).

(4) The four leading activities causing sports and exercise-related air evacuation injuries are basketball (26.6%), football (17.7%), physical training (16.2%), and weightlifting (13.7%).

(5) Table 8 depicts the five most common injuries caused by the leading sports and exercises among deployed service members from 2001–2008.

Table 8. Distribution of the Five Most Common Injuries for Basketball, Football, Physical Training, and Weightlifting, CY 2001–2008

Leading 5 Diagnoses (ICD-9-CM) by Sport	Frequency (n)	Percent of Sport Total (%)
<b>Basketball (n=729)</b>		
Knee, meniscal tears (836.0 - 836.2)	96	13.2
Rupture, Achilles tendon (727.67)	91	12.5
Sprain and strain, knee (844)	50	6.9
Rupture, patellar tendon (727.66)	37	5.1
Fracture, radius and ulna (813)	32	4.4
Fracture, ankle (845.0)	32	4.4
<b>Football (n=468)</b>		
Knee, meniscal tears (836.0 - 836.2)	53	11.3
Fracture, fingers and thumb (816)	40	8.5
Internal derangement, knee (717)	24	5.1
Fracture, wrist (814)	21	4.5
Fracture, radius and ulna (813)	18	3.8
<b>Physical Training (n=443)</b>		
Knee, meniscal tears (836.0 - 836.2)	46	10.4
Disorders of the back (724)	32	7.2
Internal derangement, knee (717)	25	5.6
Sprain and strain, knee (844)	18	4.1
Sprain and strain, shoulder (840)	16	3.6
<b>Weight Training (n=377)</b>		
Sprain and strain, shoulder (840)	40	10.6
Rupture of muscle, unspecified (728.83)	29	7.7
Disorders of the back (724)	28	7.4
Rupture, biceps tendon (long head) (727.62)	20	5.3
Disorders of muscle & tendons, shoulder (726.0 - 726.2)	16	4.2

(5) The leading injury types were fracture (28 percent), dislocation (18 percent), and disorders of muscle-tendon (15 percent). The knee (26 percent) and ankle/foot (17 percent) were the leading anatomical sites, followed by the wrist/hand (14 percent) and shoulder (12 percent). (See Figure 18.)

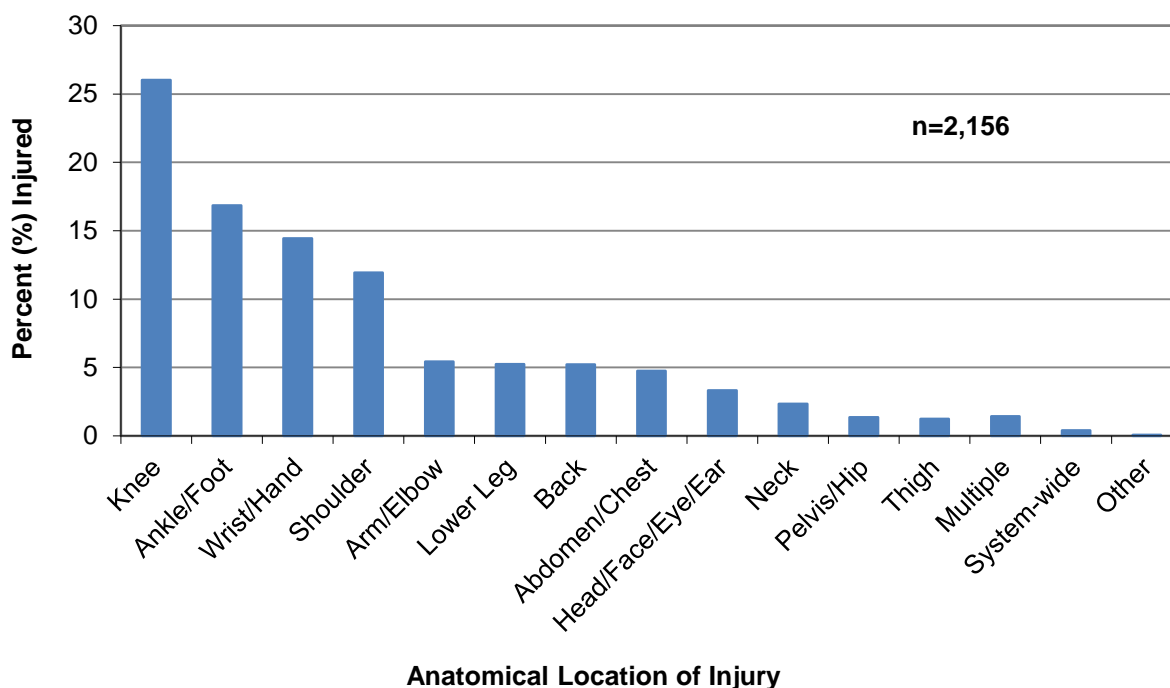


Figure 18. Distribution of Anatomical Location for Sports and Exercise-related Injuries Air Evacuated from Iraq and Afghanistan, CY 2001–2008

d. Conclusions.

(1) The annual NBI fatality rate for OEF was almost two times higher than that for OIF (OEF: 130/100,000 soldier-years; OIF: 71/100,000). The leading causes of NBI fatalities for OIF and OEF combined were land transport accidents, self-inflicted injuries, and air transport accidents.

(2) Falls were the leading cause (25 percent) of serious NBIs air evacuated from Iraq and Afghanistan. These injuries, many of which are preventable, negatively impact soldier work performance and unit readiness during deployments.

(3) Sports and exercise-related injuries comprised 21 percent of the NBIs air evacuated from Iraq and Afghanistan. Due to the impact of these injuries on lost duty

time and military readiness, identifying, evaluating, and implementing strategies to prevent them should be a high priority for military leaders.

e. Recommendations for Commanders.

(1) Use evidence-based countermeasures and safety guidelines to lower the injury risk. <sup>(33)</sup>

(2) Leaders and Soldiers should use composite risk management (CRM) to identify hazards and control risks across all Army missions and activities.

(3) Timely and accurate reporting is critical any time a mishap occurs. It is imperative that all accidents are investigated and reported.

(4) Focus attention of strategies that will aid in preventing injuries from leading causes of injury.

(a) To prevent sports and physical training injuries:

i. Avoid training too hard or too long when beginning or changing activities.

ii. Gradually increase how often and how long you train after a break in training due to leave, illness, or redeployment.

(b) To prevent motor-vehicle related injuries:

i. Use ground guides to ensure vehicles are not traveling too fast for high risk or heavily populated areas. Train all personnel when to use a ground guides and how to execute ground-guiding procedures.

ii. Secure personnel and cargo – seat belts and gunner restraints      save lives and prevent injury.

iii. Rehearse rollover, emergency egress and rescue drills prior to each mission.

iv. Establish and enforce safe speed limits for the road and environment.

(c) To prevent fall-related injuries:

i. Inspect the facilities on the operating base to identify and remove hazards that may lead to slips, trips, and falls indoors and outdoors.



- ii. Remove trip hazards from sidelines of basketball courts and sport fields.
- iii. When feasible, ensure personnel use fall protection when working at heights.
- iv. Conduct spot checks to ensure appropriate guards and barriers are in place.

6. POINT OF CONTACT. The point of contact at USAPHC is the Epidemiology and Disease Surveillance Portfolio, Injury Prevention Program, commercial 410-436-4655 or DSN 584-4655. Inquiries may also be submitted electronically at [usarmy.apg.medcom-phc.mbx.injuryprevention@mail.mil](mailto:usarmy.apg.medcom-phc.mbx.injuryprevention@mail.mil).

BONNIE TAYLOR  
Epidemiologist  
Injury Prevention Program

Reviewed by:

DR. BRUCE H. JONES  
Program Manager  
Injury Prevention Program

## APPENDIX A

### REFERENCES

1. U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM). 2009. Injury Prevention Report No. 12-HF-04MT-08, Prevention of Injuries in the Military: The Process, Priorities, and Epidemiologic Evidence.
2. Jones BH, Hansen BC. 1996. Injuries in the Military: A Hidden Epidemic. USACHPPM: Aberdeen Proving Ground, MD.
3. Harman DR, Hooper TI, Gackstetter GD. 2005. Aeromedical evacuations from Operation Iraqi Freedom: A descriptive study. *Mil Med* Vol 170 No. 6:521-525.
4. Congressional Research Service. 2009. United States Military Casualty Statistics: Operation Iraqi Freedom and Operation Enduring Freedom. (Prepared by Fischer, H.)
5. Armed Forces Health Surveillance Center. Medical evacuations from Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF), active and Reserve components, U.S. Armed Forces, October 2001-September 2009. *Medical Surveillance Monthly Report (MSMR)*. 2010 February;17(2):2-7.
6. Wojcik BE, Humphrey RJ, Czejdó B, Hassell LH. 2009. U.S. Army disease and non-battle injury model, refined in Afghanistan and Iraq. *Mil Med* Vol. 173 No. 9:825-835.
7. Sanders JW, Putnam, SD, Frankart C, Frenck RW, Monteville, MR, Riddle MS, Rockabrand DM, Sharp TW, Tribble DR. 2005. Impact of Illness and Non-Combat Injury During Operations Iraqi Freedom and Enduring Freedom (Afghanistan). *Am J Trop Med Hyg* Vol 73 No. 4:713-719.
8. USACHPPM. 2008. Injury Prevention Report No. 12-HF-0AN7a-09, U.S. Army Deployment Injury Surveillance Summary CY 2007.
9. USACHPPM. 2009. Injury Prevention Report No. 12-HF-0C7f-10, U.S. Army Deployment Injury Surveillance Summary CY 2008.
10. USAPHC. 2010. Deployment Injury Surveillance Summary, U.S. Army Operations Iraqi Freedom/Operation Enduring Freedom Calendar Year 2009 1 January–31 December 2009.

11. Fischer, H. 2010. *U.S. Military Casualty Statistics: Operation New Dawn, Operation Iraqi Freedom, and Operation Enduring Freedom*. Congressional Research Service, September 28, 2010.
12. Joint Chiefs of Staff, Manpower and Personnel Directorate, monthly reports. <http://siadapp.dmdc.osd.mil/>
13. NATO STANAG 2050 MED (Edition 5). 1989. Standardized Classification of Diseases, Injuries, and Causes of Death.
14. Barell V, Aharonson-Daniel L, Fingerhut LA, Mackenzie EJ, Ziv A, Boyko V, Abargel A, Avitzour M, Heruti R. 2002. An Introduction to the Barell Body Region by Nature of Injury Diagnosis Matrix. *Inj Prev* Vol. 8 No.2:91-96.
15. Statistical Information Analysis Division, Defense Manpower Data Center. (2010). Data accessed AUG 2010.
16. Hauret KG, Taylor BJ, Clemmons N, Block S, Jones BH. 2010. Frequency and Causes of Nonbattle Injuries Air Evacuated from Operations Iraqi Freedom and Enduring Freedom, U.S. Army, 2001–2006, *Am J Prev Med* Vol. 38 No.1:S94-S107.
17. USACHPPM. 2009. Injury Prevention Report No. 12-HF-056Sc-08, Causes of Nonbattle Injury Fatalities Among US Army Soldiers During Operation Enduring Freedom and Operation Iraqi Freedom, 2001-2006.
18. Zouris JM, Wade AL, Magno CP. 2009. Injury and Illness Casualty Distributions among U.S. Army and Marine Corps Personnel during Operation Iraqi Freedom. *Mil Med* Vol. 73 No. 3:247-252.
19. Enad JG, Headrick JD. 2009. Orthopedic Injuries in U.S. Casualties Treated on a Hospital Ship During Operation Iraqi Freedom. *Mil Med* Vol. 173 No. 10:1008-1013.
20. Kuehn BM. 2009. Soldier Suicide Rates Continue to Rise: Military, Scientists Work to Stem the Tide. *JAMA*; Vol. 301 No. 11:1111-1113.
21. Sitler M, Ryan J, Wheeler B, McBride J, Arciero R, Anderson J, et al. 1994. The efficacy of a semirigid ankle stabilizer to reduce acute ankle injuries in basketball. A randomized clinical study at West Point. *Am J Sports Med* Vol. 22 No. 4:454-461.
22. Rovere GD, Clarke TJ, Yates CS, Burley K. 1988. Retrospective comparison of taping and Ankle stabilizers in preventing ankle injuries. *Am J Sports Med* Vol 16 No. 3:228-233.

23. Sharpe SR, Knapik J, Jones B. 1997. Ankle braces effectively reduce recurrence of ankle sprains in female soccer players. *J Athl Train* Vol.32No. 1:21-24.
24. Larrison WI, Hersh PS, Kunzweiler T, Shingleton BJ. 1990. Sports-related Ocular Trauma. *Ophthalmology* Vol.97No.10:1265-1269.
25. Webster DA, Bayliss GV, Spadaro JA. 1999. Head and face injuries in scholastic women's lacrosse with and without eyewear. *Med Sci Sports Exerc.* Vol 31 No. 7:938-941.
26. Stuart MJ, Smith AM, Malo-Ortiguera SA, Fischer TL, Larson DR. 2002. A comparison of facial protection and the incidence of head, neck, and facial injuries in Junior A hockey players. A function of individual playing time. *Am J Sports Med.* Vol. 30 No. 1:39-44.
27. Psolka M, Bower KS, Brooks DB, Donnelly SJ, Iglesias M, Rimm WR, Ward TP. 2009. Ocular Diseases and Nonbattle Injuries Seen at a Tertiary Care Medical Center during the Global War on Terrorism. *Mil Med* Vol. 172 No. 5:491-497.
28. Hammett M, Pearse L, Naito N, Watts D, Hooper T. 2009. Drowning Deaths of U.S. Service Personnel Associated with Motor Vehicle Accidents Occurring in Operation Iraqi Freedom and Operation Enduring Freedom, 2003-2005. *Mil Med* Vol. 172 No. 8:875-878.
29. USACHPPM. 2005. Technical Report No. 12-MA-03Z8-05. Risk Factors for High Mobility Multi-purpose Wheeled Vehicle (HMMWV) Accidents and Other Important Injuries during Operations Iraqi Freedom and Enduring Freedom, Calendar Years 2003–2004.
30. Bell NS, Amoroso PJ, Yore MM, Smith GS, Jones BH. 2000. Self-Reported Risk Taking Behaviors and Hospitalization for Motor Vehicle Injury among Active Duty Army Personnel. *Am J Prev Med.* Vol. 18 No.3S: 85-95.
31. Pollack K, Canham-Chervak M, Gazal-Carvalho C, Jones B, Baker S. 2005. Interventions to prevent softball related injuries: a review of the literature. *Inj Prev* Vol. 11 No. 5:277-281.
32. Knapik JJ, Marshall SW, Lee RB, Darakjy SS, Jones SB, Mitchener TA, et al. 2009. Mouthguards in sport activities: history, physical properties and injury prevention effectiveness. *Sports Med* Vol. 37 No. 2:117-144.

Injury Prevention Report No. S.0000614-10

33. Deployment Guide for Brigade Combat Team. 2011. USACR/Safety Center.  
Accessed 03 June 2013 <[https://safety.army.mil/ako\\_auth/DeploymentGuideWeb/BCTSP%20Guide %2020110718.pdf](https://safety.army.mil/ako_auth/DeploymentGuideWeb/BCTSP%20Guide%2020110718.pdf)>.

## APPENDIX B

## BARELL INJURY DIAGNOSIS MATRIX AND ASSOCIATED ICD-9-CM 800-995 CODES

[illegible]

## APPENDIX C

INJURY-RELATED MUSCULOSKELETAL CONDITION MATRIX AND  
ASSOCIATED ICD-9-CM 710-739 CODES

Injury Location			Inflammation and Pain (Overuse)	Joint Derangement	Joint Derangement with Neurological Involvement	Stress Fracture	Sprains/Strains/ Rupture	Dislocation
	Vertebral Column	Cervical	723.1	722.0	722.71, 723.4			
		Thoracic/Dorsal		722.11	722.72, 724.4			
		Lumbar	724.2	722.10	722.73, 724.3			
		Sacrum, Coccyx	720.2					
		Spine, Back Unspecified	721.7, 724.5	722.2	722.70, 724.9	733.13		
Extremities	Upper	Shoulder	716.11, 719(.01,.11,.41), 726(.0,.1,.2)	718(.01,.11,.81,.91)			727(.61-.62)	718.31
		Upper arm, Elbow	716.12, 719(.02,.12,.42), 726.3	718(.02,.12,.82,.92)		733.11		718.32
		Forearm, Wrist	716.13, 719(.03,.13,.43), 726.4	718(.03,.13,.83,.93)		733.12		718.33
		Hand	716.14, 719(.04,.14,.44)	718(.04,.14,.84,.94)			727(.63-.64)	718.34
	Lower	Pelvis, Hip, Thigh	716.15, 719 (.05,.15,.45), 726.5	718(.05,.15,.85,.95)		733(.14-.15)	727.65	718.35
		Knee, Lower leg	716.16, 717.7, 719(.06,.16,.46), 726.6	717(.0-.6,.9), 718(.06,.16,.86,.96)		733(.16,.93)	717.8, 727(.66-.67)	718.36
		Ankle, Foot	716.17, 719(.07,.17,.47), 726.7, 728.71, 734	718(.07,.17,.87,.97)		733.94	727.68	718.37
Unclassified by Site	Others and Unspecified	Other specified/Multiple	716(.18-.19), 719(.08-. .09,.18-.19,.48-.49), 726.8, 727.2	718(.08,.09,.18,.19,.88,. 89,.98,.99)		733.19	727.69	718(.38,.39)
		Unspecified Site	716.10, 719(.00,.10,.40), 726.9, 727.3, 729.1	718(.00,.10,.80,.90)	729.2	733(.10,.95)	727.60, 728.83	718.30